SCIENTIFIC AMERICAN

ACTORS IN SELF-CONTAINED DIVING SUITS, IN AN UNDERWATER PHOTOPLAY SCENE.—[See page 78]

July 22, 1916

Munn & Co., Inc., Publishers
New York, N. Y.

Price 10 Cents

Pulls you out of trouble

Sooner or later an accident like this may happen to you—or you may skid into a ditch, or your car may overturn. It is then that you will bless the day that you decided to buy a Pull-U-Out.

With this powerful and wonderful little device in your tool box you will have no fear of bad roads, because you will know that inside ten minutes you can be out of trouble and on your way rejoicing.

In 5 minutes you have the three strong stakes anchored in the ground tandem fashion—leaning towards the auto. Hitch on to them, and in 5 minutes more your car is out. No gasolene wasted, no strained engine or differentials through trying to get the car out on its own power, no waiting for a passing auto or conveyance to help you, no walking miles to the nearest house for assistance.

You Should Have One in *Your* Auto

You will be up against it if you don't. Besides you'll have to pay for help, soiled clothes, damage to engine and tires—more than a Pull-U-Out would cost.

Or if your car overturns and someone near and dear to you is pinned underneath, are you going to let them stay there until you can find help to enable you to right the car? In such a predicament you would gladly give a thousand times the small price of a Pull-U-Out to relieve them quickly from their suffering.

Buy a Pull-U-Out *now* and be independent of other help when trouble comes.

Stake 1/6 Actual Size

Saves Money in Factories

Pull-U-Out will revolutionize present methods of hoisting in your factory or shop, because it can be easily and quickly moved from one job to another, and made to do the work of a dozen chain blocks. It will save the time and labor of several men.

Pull-U-Out is lighter than a chain block, has longer reach, costs less than half, will work in any position and pulls as well as lifts. Its low cost combined with its great efficiency make it possible to rig a separate Pull-U-Out over each machine or beside each operator who has lifting to do.

Ideal for Garages and Repair Shops

There isn't a garage in the country that can't find hundreds of uses for Pull-U-Out. It saves time and wages because the job need not be taken to the hoist—you take Pull-U-Out to the job. You do not have to move one job out of the way to make room for the next. It's great for removing engines, changing bodies, lifting heavy vulcanizing frames, putting in new axles and doing all other kinds of lifting or repair work.

On your wrecking car Pull-U-Out is the best and quickest means for righting overturned cars, or pulling mired autos out of the mud. It will save time, temper, damage to your own tires from spinning on the road, and the work will be done better, quicker and cheaper.

Does Jobs No Other Machine Can Do

Pull-U-Out does jobs for which no mechanical help has heretofore been provided, such as setting boilers, shifting machinery, lowering vaults and setting stones in cemeteries, placing ceiling radiators, pulling wires through conduits, spotting cars, stretching wire fences, pulling stumps, setting telegraph poles, hoisting painters' rigging, loading and unloading trucks, farm wagons, etc. Pull-U-Out and one man will do such jobs which now require several men.

Sold on a Make Good Basis

You take no risk in buying a Pull-U-Out. So *sure* are we that it *will* do what we claim for it, that we guarantee to refund your money in full if it does not come up to your expectations. Leading dealers are selling Pull-U-Out on these terms. If your dealer doesn't sell Pull-U-Out, write us. Canadian orders promptly filled from our Canadian Depot.

PULL-U-OUT Portable Crane weighs only 250 lbs., will lift one ton 9 ft. 6 ins., easily moved about. Better than an overhead track system. Slip-jointed, can be put together with S wrench in 5 minutes.

Write for Interesting Booklet

Tells all about Pull-U-Out, how it works and the hundred and one uses it can be put to. You'll profit by reading it. Write for your copy today—it's free.

Pull-U-Out Sales Co.
2037 Market St., St. Louis, Mo.

METAL-WORKING

A selected list of practical books treating on the various branches of metal-working, including die work, hardening and tempering, drop forging, tool making, lathe work, machine shop practice, etc.

Dies: Their Construction and Use for the Modern Working of Sheet Metals

By JOSEPH V. WOODWORTH. 6¼ x 9¼. Cloth. 384 pages, 505 illustrations. Price, $3.00.

¶ A practical work on the design, construction and use of dies, punches, tools, fixtures and devices for the press working of metals, together with the manner in which they should be used in the power press for the cheap and rapid production of sheet metal parts and articles.

Punches, Dies and Tools for Manufacturing in Presses

By JOSEPH V. WOODWORTH, M. E. 6¼ x 9¼. Cloth. 483 pages, 702 illustrations. Price, $4.00.

¶ This volume might well be termed an encyclopedia of die-making, punch-making die-sinking, sheet metal working, and making of special tools, sub-presses, devices and mechanical combinations for piercing, punching, cutting, bending, forming, drawing, compressing, and assembling sheet metal parts and also articles of other materials in machine tools.

Drop Forging, Die Sinking and Machine Forming of Steel

By JOSEPH V. WOODWORTH. 6¼ x 9¼. Cloth. 341 pages, 304 illustrations. Price, $2.50.

¶ A complete practical treatise on the hot and cold machine forming of steel and iron into finished shapes, together with the tools, dies and machinery involved in the manufacture of duplicate forgings and interchangeable hot and cold pressed parts from bar and sheet metal.

American Tool Making and Interchangeable Manufacturing

By JOSEPH V. WOODWORTH. 6 x 9¼ Cloth. 535 pages, 601 illustrations. Price, $4.00.

¶ A complete treatise on the design, construction, use and installation of tools, jigs, fixtures, devices, special appliances, sheet metal working processes, automatic mechanisms and labor-saving contrivances, together with their use in the lathe, milling machine, turret lathe, screw machine, boring mill, power press, drill, sub-press, drop hammer, etc., for the working of metals and the production of interchangeable machine parts.

Machine Shop Tools and Shop Practice

By WILLIAM H. VAN DERVOORT, M. E. 6¼ x 9¼. Cloth. 552 pages, 672 illustrations. Price, $3.00.

¶ This work describes in detail the construction, operation and manipulation of both hand and machine tools. Includes chapters on filing, fitting and scraping surfaces; drills, reamers, taps and dies; lathe and lathe tools; planers and shapers and their tools; milling machines and cutters; gear cutters and gear cutting; drilling machines and drill work; grinding machines and their work; hardening and tempering; gearing, belting and transmission machinery; useful tables and data.

Hardening, Tempering, Annealing and Forging of Steel

By JOSEPH V. WOODWORTH. 6¼ x 9¼. Cloth. 288 pages, 201 illustrations. Price, $2.50.

¶ Treats clearly and concisely all modern processes for the heating, annealing, forging, welding, hardening, tempering and case-hardening of steel, making it a work of great value to tool makers and metal-working mechanics in general. Special directions are given for the successful hardening and tempering of steel tools of every description, also methods for the treatment of special brands of steel.

Steel

Its Selection, Annealing, Hardening and Tempering

By E. R. MARKHAM. 5¼ x 7¼. Cloth. 396 pages, 168 illustrations. Price, $2.50.

¶ Gives comprehensive and specific instructions on the methods of hardening a large number of tools. All kinds of annealing and muffle furnaces, blast ovens, open flames, and the use of the lead and cyanide baths are fully described. Case-hardening and pack hardening are treated in a comprehensive manner. A standard work by an acknowledged authority.

Modern American Lathe Practice

By OSCAR E. PERRIGO, M. E. 6¼ x 9¼. Cloth. 424 pages, 314 illustrations. Price, $2.50.

¶ Describes and illustrates the very latest and best practice in lathe and boring-mill operations as well as the history, design, construction and classification of these important classes of machine tools.

WE FORWARD THESE BOOKS POSTPAID UPON RECEIPT OF THE ADVERTISED PRICES.

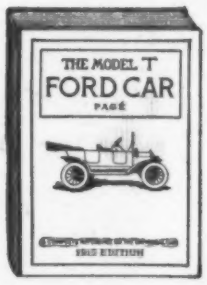
ARE YOU INTERESTED IN SCIENTIFIC AND TECHNICAL BOOKS? IF SO, WRITE FOR OUR CATALOGUE WHICH WE MAIL FREE ON REQUEST.

MUNN & CO., Inc., Publishers, 233 Broadway, New York, N. Y.

JUST PUBLISHED

A New, Complete Book for every Ford Owner, Dealer, Salesman and Repairman.

The Model T Ford Car



Its Construction, Operation and Repair

By VICTOR W. PAGE, M.E.
Author of "The Modern Gasoline Automobile," etc.

300 (5x7) Pages. Over 100 Specially Made Engravings and 2 Large Folding Plates

Price $1.00 Postpaid

This is the MOST COMPLETE and PRACTICAL instruction book ever published on the FORD CAR. All parts of the Ford Model T Car are described and illustrated in a comprehensive manner—nothing is left for the reader to guess at. The construction is fully treated and OPERATING PRINCIPLES MADE CLEAR TO EVERYONE. Complete instructions for driving and repairing are given. Every detail is treated in a non-technical yet thorough manner.

This book is written specially for FORD DRIVERS AND OWNERS, by a recognized automobile engineering authority and an expert on the FORD, who has driven and repaired Ford Cars for a number of years. He writes for the average man in a practical way from actual knowledge. ALL REPAIR PROCESSES ARE ILLUSTRATED AND FULLY EXPLAINED.

WRITTEN SO ALL CAN UNDERSTAND—NO THEORY, NO GUESSWORK
AUTHORITATIVE—UNBIASED—INSTRUCTIVE—COMPLETE

Contains Special Chapters on

1. **The Ford Car.** Its parts and their functions. The Ford Three Point Suspension System—Frame Assembly Details—Spring Construction—The Ford Body—The Ford Power Plant, Etc. 2. **The Engine and Auxiliary Groups.** How the engine works, the fuel supply system, the carburetor, making the ignition spark, cooling and lubrication.—Induction Coil System Action Explained—Why a Magneto Is Used on a Ford—Wiring Dry Cell Batteries—Master Vibrator Systems—The Ford Muffler, Etc. 3. **Details of Chassis.** Change speed gear, power transmission, differential gear action, steering gear, front axle, frame and springs, brakes, etc. 4. **How to Drive, and Care of the Ford.** The control system explained, starting the motor, driving the car, locating roadside troubles, tire repairs, oiling the chassis, winter care of car.—Lighting System—Electric Lighting for Ford Cars—A Typical Engine Stop Analyzed—Conditions that Cause Failure of the Ignition System—Common Defects in Fuel Systems—Adjusting Transmission—Adjusting Loose Front Wheels—What to Do When Rear Brakes Do Not Hold, Etc. 5. **Overhauling and Repairing Mechanism.** Systematic location of troubles and remedies—Faults in Power Plant and Symptoms—Value of System in Overhauling—How to Take Down Motor—Carbon Deposits and Their Removal—How to Repair Cracked Water Jacket—Reseating and Truing Valves—Method of Valve Grinding—Inspection of Piston Rings—Piston Ring Manipulation—Fitting Piston Rings—Wrist Pin Wear—Inspection and Refitting of Engine Bearings—Knocking Indicates Loose Bearings—Adjusting Main Bearings—Scraping Bearing to Fit—Rebabbitting Connecting Rod—Testing Bearing Parallelism—Camshafts and Timing Gears—How to Time Valves in Ford Engines—Repairing Ford Magneto—Packings and Gaskets for Ford Engines—Precautions in Reassembling Parts—How to Take Down Transmission—Relining Brake Bands—Rear Axle Troubles and Remedies—Care of Springs—Steering Gear Repairs—Miscellaneous Chassis Parts, Etc., Etc.

The illustrated chapter on repairing and overhauling alone is worth many times the price of this book.

MUNN & CO., Inc.
233 Broadway **Woolworth Building** **New York, N. Y.**

SEVENTY-SECOND YEAR

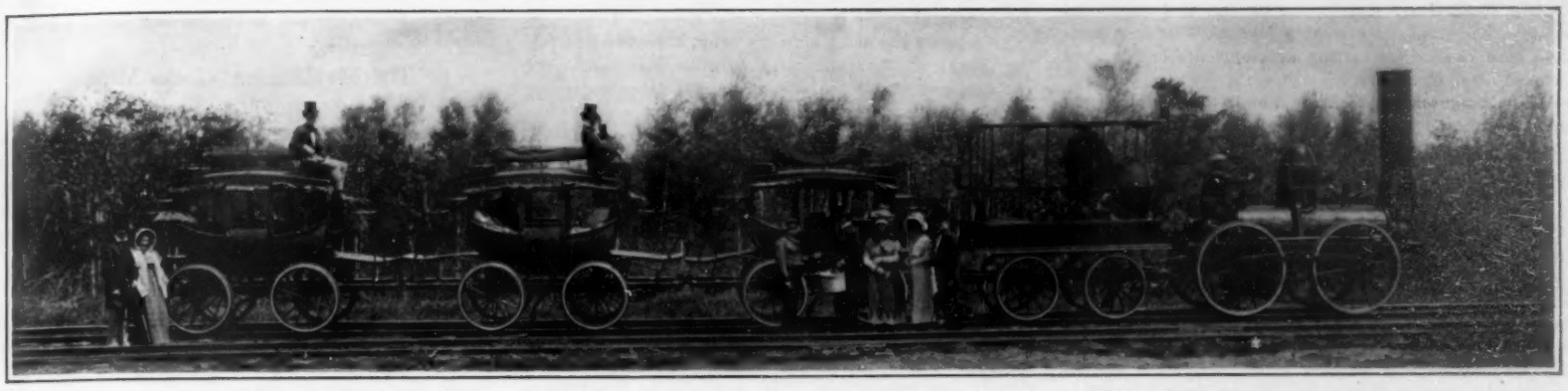
SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

VOLUME CXV. NUMBER 4

NEW YORK, JULY 22, 1916

10 CENTS A COPY
$3.00 A YEAR



A replica of the famous "De Witt Clinton" steam locomotive and its train of coaches at Karner, N. Y., posed before the motion picture camera

Pioneer Locomotive Poses for the Motion Picture Camera

ON a bright sunshiny morning in May, 1916, a strange scene was staged in the Karner, N. Y., freight yard of the N. Y. C. & H. R. R. R. when a replica of the "De Witt Clinton," hauling a train of three antique stage coach passenger cars, re-enacted the start of the first steam railroad journey in the State of New York, before the watchful eye of a moving picture camera.

In order to reproduce as accurately as possible all the conditions of the pioneer trip of August 9th, 1831, the passengers and train crew were dressed in old time costumes and the train was run upon a side track lying along the original right-of-way, so that the only inharmonic feature was the unavoidable use of the modern heavy rails which were, of course, undreamed of when the initial trip was made.

This unique train with its diminutive cars and queerly costumed passengers formed a marked contrast to the giant modern locomotives and heavy vestibuled trains which thundered by at intervals on the adjacent main line tracks during the taking of the picture, thereby enabling the spectators to visualize at one glance the extent of the progress of railroad development during the past 85 years.

While the entire old time train could be housed in a typical passenger coach of to-day, it proves on close examination to be a very creditable production from a mechanical standpoint; and while its design would be productive of smiles in any modern locomotive plant, the machinists of our grandfathers' days would not have to apologize for their workmanship. This statement is made on the assumption that the present replica of the De Witt Clinton is an accurate reproduction of the original.

The original locomotive was built and placed in service in about two months, and in actual operation it gave considerably better service than its designers had anticipated, although numerous difficulties developed during the tuning up trials which preceded its first official trip. It was the third locomotive built in America and was designed for a maximum steam pressure of 50 pounds, developed about 10 horse-power, and was expected to give a tractive effort of about 15 tons on a level track. It is interesting to note that the wheel spacing was the present standard gage.

A letter written in 1859 by David Matthew, the first engineer of the De Witt Clinton, contains some interesting data in regard to the construction details, as indicated by the following extract:

"I left New York with the 'De Witt' on the 25th of June, 1831, and had steam on to commence running in one week from that time. The 'De Witt' had two cylinders 5½ inches in diameter and 16 inches stroke; four wheels, all drivers, 4½ feet diameter, with all the spokes turned and finished. The spokes were wrought-iron, hubs cast-iron, and the wheels tired with wrought-iron, inside crank and outside crank connecting-rods to connect all four wheels; a tubular boiler with drop furnace, two fire-doors, one above the other; copper tubes 2½ inches in diameter and about 6 feet long; cylinders on an incline, and the pumps worked vertically by bell-crank. This engine weighed about 3½ tons without water, and would run 30 miles an hour with three to five cars on a level, with anthracite coal, and was the first engine run in the State of New York on a railroad."

It was said that the original locomotive was so well built that it could be readily pushed along by the pressure of one hand, and this statement is probably correct, as the writer found that by exerting considerable effort he could, without assistance, slowly move the entire train.

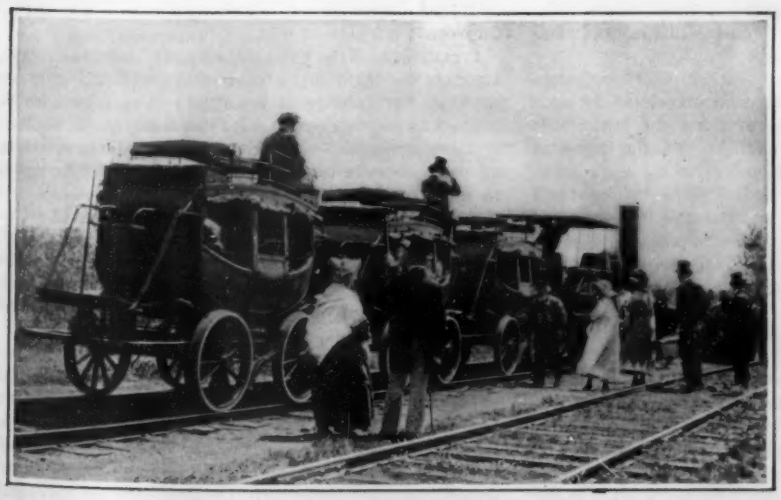
Though it appears to be dwarfed by comparison with its modern successors and to our eyes seems almost toy-like in its proportions, the "De Witt Clinton" was a very portentous piece of machinery in our grandfathers' days and their viewpoint can perhaps be best comprehended by reference to an old account of the momentous pioneer trip.

"The flight of that first train had been pretty well advertised, and the whole countryside had turned out to see it. Farmers, with their families and their wives' relations, had driven over to the road in lumber-wagons, light wagons, and all sorts of conveyances, and being naturally desirous of obtaining a good view, had driven up as close to the track as they could get. The track for nearly the entire distance from Albany to Schenectady was lined with farmers' rigs like the infield fence at a race-course.

When the engine came snorting along, the horses, with their noses close enough to the track to touch the monster as it came along, did what any self-respecting horses might be expected to do under such circumstances—that is, they reared, snorted, shied, and ended by running away. The result was a grand stampede all along the line, which strewed the right-of-way with prostrate forms and debris until it looked like a battle-field at the close of a great conflict."

New Alphabet in Use by the Chinese Students

THE first class of students trained to read the Chinese language by means of the newly invented alphabet graduated recently from a school in Shanghai, although the school in which they were trained was opened only a few months ago. What the students have learned was put to a practical test in the presence of the Minister and Vice-Minister of Education. Each student was given a sheet of blank paper on which he wrote a number of questions after the new style. These questions were to be answered by another student seated in another quarter of the hall. This having been done, the minister dictated a number of questions in Mandarin and told the students to answer them. It is remarkable how clearly these answers were given, according to the *National Review* of Shanghai, and it is reported that the spectators were astonished. The principal of the school explained that any two boys who have been to school can be taught to correspond with each other in four months' time by means of the new alphabet.



Rear end of the "De Witt Clinton" train. The entire train can be pushed forward by one man, which speaks well for its construction

The locomotive "De Witt Clinton," the original of which was the third locomotive built in America, and placed in commission on August 9, 1831

SCIENTIFIC AMERICAN

Founded 1845

Published by Munn & Co., Inc., 233 Broadway, New York, Saturday, July 22, 1916

Charles Allen Munn, President, Frederick C. Beach, Secretary. Orson D. Munn, Treasurer, all at 233 Broadway

Entered at the Post Office of New York, N. Y., as Second Class Matter
Entered as Second Class Matter at the Post Office Department, Canada
Trade Mark Registered in the United States Patent Office

The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.

The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.

Submarines in the Merchant Service

IT would be ungenerous to say anything derogatory to the initiative resourcefulness, and skill which produced the submarine merchant ship "Deutschland," carried her through the British blockade and across the Atlantic Ocean, and landed her in an American port with safety and dispatch. There are many features about this exploit which render it unique among the annals of the sea. The "Deutschland" is the first submarine to make the westward passage; with the possible exception of a few of the latest German naval submarines, which are credited with a displacement of 2,200 tons, she is the largest submarine yet constructed; she is the first submarine to be built for purely commercial purposes,—for torpedoes and rapid-fire guns she has none; she is the first submarine to sail the seas under the protection of the ancient and time-honored laws of visit and search, for the observance of which on the part of German naval submarines our President labored so long, and at last, so successfully.

There can be no doubt whatsoever as to the status of the "Deutschland" as a peaceful merchant vessel; and, as such, should she be overtaken by one or more British destroyers or patrol boats when she reaches European waters, the worst that could happen would be her capture and removal to a British port, or her being sunk after her officers and crew had been taken aboard the enemy's ship.

The "Deutschland" is an abnormal vessel, built to meet the abnormal conditions of the blockade of Germany by the British fleet. Did she carry an ordinary cargo, she would be a highly interesting and sensational but very costly experiment; but her construction and operation are rendered highly profitable by the fact that there are certain commodities manufactured almost exclusively in Germany, the secrets of whose manufacture are known only in Germany, which have reached such an enormous value in this country (we are speaking now of dyestuffs and certain special chemicals) that the bringing to this country of even such small cargoes as the "Deutschland" can carry renders the enterprise an extremely profitable undertaking.

It is reported that the "Deutschland" has a cargo capacity of seven hundred tons. It is certain that several hundred tons of freight were carried on this first trip, and rumor has it that the boat will take back a full cargo of rubber and nickel, both of which are in the very greatest demand just now in Germany for war purposes.

The "Deutschland" and her sisters, should they escape capture, will doubtless carry full cargoes and earn very big profits for the enterprising men who are back of this venture, as long as the war shall last. With the coming of peace, of course, their work will be ended; for a vessel of this type cannot possibly compete as a freight carrier with the average, cheaply built tramp of large cargo capacity. In peace times the submerging ability of the "Deutschland" fleet will be useless, and, except in the very roughest weather, will never be exercised. It would be possible, of course, to remove the motors and the heavy electrical storage batteries. This would add greatly to the cargo capacity and, under these conditions, it is possible that the boats might find a field for useful service in the coastal and inland water trade.

The True Story of the Jutland Fight

IF the German account of the Jutland sea fight, with its absurd claim of a sweeping victory is ignored, Germany has only herself to blame. That the German fleet could be engaged in a terrific five-hour fight with the greatest navy in the world, and come out of it with no greater loss than that of an old battleship, two or three small cruisers, and a few destroyers, is a proposition whose absurdity is evident even to the lay mind. The tardy acknowledgment by the German Admiralty that the battle-cruiser "Lutzow" and the light cruiser "Rostock" had been sunk, and that these losses had been concealed "for military reasons," only serves to increase the public distrust of any account of this fight that emanates from German official quarters.

The British Government, on the other hand, from the very first promptly acknowledged its losses; in fact, the earlier accounts of the fight from British sources were somewhat prejudicial to the work of the British fleet. Consequently, the lengthy and detailed report of the fight recently made by Vice-Admiral Sir John R. Jellico to the Admiralty has been accepted as giving as close an approximation as possible to the sequence of events in the great battle and the losses actually suffered by the British and German fleets.

As regards the ships actually sunk, Vice-Admiral Jellico says: "After the most careful examination of the evidence of all the officers who testified to seeing enemy vessels actually sink, and after personal interviews with a large number of these officers, I am of the opinion that the minimum number of ships of the enemy sunk is as follows: "Two dreadnought battleships; one predreadnought battleship of the "Deutschland" type (probably the "Pommern"); the battle-cruiser "Lutzow"; one battle-cruiser, name not ascertained; one battle-cruiser so severely damaged that she probably sank before reaching a home port; five light cruisers seen to sink (one of these possibly a battleship); six destroyers seen to sink; three destroyers so much damaged that they probably foundered; one submarine. "In addition to the vessels sunk," says Admiral Jellico, "it is unquestionable that many other ships were very seriously damaged by gun-fire and torpedo attack."

As regards the tactics of this stupendous fight, it is sufficient to refer to our article in the SCIENTIFIC AMERICAN of June 17th, in which we gave the courses and maneuvers of the successive stages of the battle. The engagement was fought very much by the book. Battleships, battle-cruisers, light cruisers and destroyers fought about as they were expected to do and with about the results which had been foretold. The outstanding lesson, surpassing every other in importance, is the dominating influence of the large-caliber, long-range gun. From first to last, through all the terrific fury of that five-hours' struggle, it was a gunners' fight. It was the concentration of the German 11- and 12-inch shells, salvo upon salvo, that sought out the vitals of the three British battle-cruisers, set off their magazines, and tore these ships asunder. So, too, it was the well-placed salvos of the British battle-cruisers and battleships that sent to the bottom the half-dozen capital ships of the German fleet, and wrought havoc upon many another ship of the line that barely managed to get back to port.

The destroyer flotillas were sent in to the attack with reckless abandon, both by day and by night, and they took a heavy toll, particularly of the German fleet. As we go to press, information comes from Holland that Germany's latest dreadnoughts "Kaiser" and "Kronprinz" were sunk by torpedoes. In the day attack a destroyer managed to get a torpedo home on the "Marlborough," but without putting the ship out of action. By the way, the experience of the "Marlborough" serves to show the furious character of the fighting. Says Admiral Jellico: "The first battle-squadron (British) at 11,000 yards administered severe punishment to enemy battleships, battle-cruisers and light cruisers. The fire of the "Marlborough" was particularly effective and rapid. She commenced by firing seven salvos at a battleship of the "Kaiser" class, and then engaged a cruiser, and next a battleship. She was hit by a torpedo at 6:54 P.M., and took a considerable list to starboard, but reopened fire at 7:03. At 7:12 she fired fourteen rapid salvos at a battleship of the "Koenig" class, hitting her frequently, until she left the line."

The misty character of the weather, which occasionally shut out the fleets from each other, led to such a decrease in the range that at times the battleships were engaging each other at ranges of eight thousand and even five thousand yards, and at both these ranges, according to Jellico's report, the ships landed their salvos with deadly accuracy. That the dreadnoughts should have stood up under what was practically point-black firing, not for one salvo, but for a continuous hammering, is a great tribute to the defensive qualities of the modern dreadnought. Perhaps the most wonderful instance of this was the case of the "Warspite," which, due to the disablement of her steering gear, was for a while the target for the concentrated fire of several German battleships. Although she was struck many times, she received no vital blow, and the losses in the crew were surprisingly small. After repairing her steering gear, she managed to join her sisters of the "Queen Elizabeth" class.

Neither the submarine nor the Zeppelin took any notable part in this, the greatest sea fight of all history. The reputed German 17-inch gun failed to materialize, and the battleships and battle-cruisers were those with which the naval annals had made us familiar.

Finally, it should be noted that Vice-Admiral Jellico not only indorses but highly commends the tactics of Admiral Beatty in attacking the superior fleet of German battle-cruisers and battleships, with a resulting loss of three of his battle-cruisers. Beatty closed in with the German fleet, and then, turning, led it a running fight in the direction of the British main fleet of battleships. That he should have sacrificed himself in the effort to hold the German fleet was in accord with the best traditions of naval history. Had he awaited Jellico's battle-squadrons, it is probable that the Germans, realizing that they were opposed by greatly superior forces, would have avoided battle and returned to the mouth of the Elbe.

The Mobilization of the Militia

THE mobilization of the National Guard, which is the organized militia of the several states, is valuable in that it serves to bring prominently before the people the actual conditions as to the defensive power of this country. From time to time during the past year there have been many articles written on this subject, some pessimistic and some optimistic. We are now in position to judge of the accuracy of the views expressed.

For one week after the call to the colors, there was practically no concentration. The various organizations assembled promptly at their armories; many patriotic young men presented themselves for enlistment, and some units proceeded to the predetermined state mobilization camps. In some instances these were not ready to receive them without further installation of water supply and other necessities. At the end of this first week there began the move to the border, the first contingents going at little more than peace strength.

In the meantime there appeared delays in equipment. The guard organizations were fully equipped for peace strength, but the clothing, equipment and other necessities for the increase to war strength had to be shipped from the depots. This was found to be a time-consuming process, and one which, if performed in haste, might easily lead to costly errors.

Under the rigid physical examination necessary to safeguard the country's future pension rolls, many of those in the state service were rejected. In their places were enlisted, generally, men without any previous training. Rejections have averaged, approximately, ten per cent. In addition there have been many cases where guardsmen were under age, and others where dependency of relatives caused issue of discharges. Furthermore, in some instances the guardsmen were in Government employ or in the employ of those working on Government contracts. These, also, had to be discharged. In all it is safe to say that 20 per cent of the original Organized Militia, have not been able to accompany their organizations.

If we remember that of the remainder approximately one third has had only one year's training, of about 50 or 60 hours drill as a maximum, and that they can themselves be considered as scarcely more than recruits, it will appear that not more than 35 men per company can be accepted as even fairly trained soldiers. These are the leaven for approximately 100 raw men required to bring the companies to war strength.

After three weeks constant effort, working day and night, we accumulated on the border about 50,000 of these loosely-knit organizations, sending them as each was reasonably well equipped. No attempt has been made to maintain a balance between the various arms of the service, infantry, cavalry and field artillery, as would be required for service together as an army. In many instances some units were so little experienced in the use of the arm to which they were assigned that they could not be sent without further training.

Practically all the animals had to be purchased. This amounts to little more than delay in case of draft animals, but cavalry and artillery horses have to be trained as do the men, and it is seriously to be doubted if these organizations without a few weeks training of their animals could maneuver effectively in peace, to say nothing of participating in battle.

So this is the result. Three weeks' effort. No consideration given expense. Every available guardsman called. And in three weeks' time 50,000 men at the border partially equipped, and not in units to form an army for tactical use, with some 50,000 more scattered over the country from coast to coast.

It is held that every argument against the militia system of the country has been upheld by this practical example of its working. The men have been as willing as ever; they have endured what to them was hardship without murmur. The officers have done all that could be done. Officers and men have accomplished all that officers and men ever have accomplished or ever will accomplish under this system. We may as well frankly face the truth. The system is a failure.

Automobile

Lighting Laws in England.— All kinds of regulations relating to the lighting of vehicles are being strictly enforced in England of late, and as a result a boy was recently fined for wheeling a perambulator after dark without a light.

The Pneumatic Tire Business.— How many people realize the sensational development that the pneumatic tire business has experienced? The first company to undertake the manufacture of pneumatic tires was the Dunlop Company, organized in Dublin, Ireland, in 1889, with a capital of about $75,000 to make tires for bicycles, and it rapidly grew to be a great business. Then came the automobile to add its demands, and to-day, only 27 years later, the pneumatic tire business of the world is estimated at the enormous sum of $650,000,000.

Changing Gears.— It may be a humiliating fact, but it is nevertheless true, that the average automobile driver cannot change gears properly. Indeed it is safe to say that a surprising majority do not perform this constantly recurring operation in a way conducive to long life of the mechanism. This may be a reflection on the intelligence and mechanical skill of the public, but the automobile builder should share the blame as he is responsible for perpetuating a mechanism involving so much uncertainty in its operation.

Substitutes for Gasoline.—Owing to the great increase in the price of gasoline all over the world substitutes are springing up everywhere. In England, where the cost of running a car is rapidly becoming prohibitive, the tendency seems to be toward heavy fuels which appear to give good results, and work well after the engine has been well warmed up by running for a few minutes on gasoline. While this is undoubtedly now regarded as a temporary expedient, desirable permanent results will probably follow from the experience gained in the use of heavier fuels.

Extinguishing Gasoline Fires.—A series of experiments recently carried out by the British Fire Prevention Committee shows that the best way to extinguish a small gasoline fire is to spread over the burning liquid a mixture of 10 pounds of bicarbonate of soda and 12 pounds of common sawdust. The sawdust need not be wet, but must be free from chips and shavings. The theory is that the sawdust, by floating on the burning liquid, excludes the oxygen of the air, and the heat of the flame generates carbonic acid gas, which helps extinguish the fire. Sawdust alone gives satisfactory results, indeed better than sand or similar materials.

Stopping Gasoline Leaks.—Leaks in a gasoline tank or pipe are not only a source of danger, but may cause inconvenience when they occur on the road, far from supplies. An old method of stopping such a leak which is known to but few, is to plaster it over with a thick paste of soap, well worked into the crevices. The old fashioned yellow bar soap is excellent for the purpose; and to make a safe temporary repair the soap plaster should be tightly wrapped with tape, or even a bandage of cloth may be used. If a little shellac is available it is well to give the wrapping a coat, which will obviate any possibility of trouble that might result from water getting on the soap from without.

Eliminating the Grease Cup.—An English inventor has revived, and improved, the old DeDion idea of distributing grease to several parts of a car from the dashboard. In its new form the device takes the form of a screw-down grease gun with what is described as a revolver base, which forms a distributor valve that can be turned to direct the grease from the gun to any one of half a dozen or more parts of the chassis, which are connected with the valve by properly located pipes. Of course heavy oil could be supplied in the same way. This is an improvement in a direction that has been too long neglected by the makers of cars; for it is obvious to everyone that many of the cunningly hidden grease cups on the modern car are regularly overlooked.

The Question of Fuel.—It would seem that the makers of automobiles, especially of commercial vehicles, are blind to their own interests in clinging so persistently to gasoline as a fuel, for there is every reason to believe that the demand for gasoline has caught up with the supply, notwithstanding the reserves now tied up in Mexico and other large resources in South America, all of which are in the hands of those controlling the present supplies. As a consequence, there is little possibility of the price of gasoline ever falling to the figures of a year ago, and every expectation that the actual world's supply will soon show indications of exhaustion. The only alternative, if internal combustion motors are to survive, is a cheaper and more abundant fuel, which, for all that can be foreseen, must be some description of oil. Automobile manufacturers persist in saying such a fuel is impossible; but they said the same thing ten years ago, when "76 gasoline" was supposed to be the only possible fuel for motor vehicles, and every one knows the difference between that liquid and what is in regular use to-day. The time for an awakening has arrived.

Science

Commander H. L. L. Pennell, R. N., who commanded the "Terra Nova" during Captain Scott's last Antarctic expedition and carried out important geographical work in that connection, was one of the many distinguished naval officers who perished in the battle of May 31st in the North Sea. He was attached to H.M.S. "Queen Mary."

Past and Present Indian Populations.— Detailed studies by Mr. James Mooney, of the Bureau of American Ethnology, lead to the conclusion that the Indian population of America, north of Mexico, at the period of the earliest white settlement was about 1,140,000, of whom about 860,000 were within the present limits of the United States. Mr. Mooney estimates that this number has been reduced by about two thirds through disease, famine and war, consequent on the advent of the white man.

The Botanical Station at Cinchona, Jamaica, was leased to the British Association for the Advancement of Science shortly before the present war began. Plans for its use by British botanists were defeated by the war, and it is now expected that the lease will pass into American hands after next October. About 14 American universities, botanical foundations and individual botanists are to coöperate with the government of Jamaica in the support of the station, which is ideally situated for research in tropical botany.

Indorsement of the Newlands Bill.— The Committee of One Hundred on Scientific Research, of the American Association for the Advancement of Science, has adopted resolutions strongly indorsing Senator Newland's bill providing for the establishment of experiment stations in engineering and other branches of the mechanic arts in connection with the land grant colleges. The resolutions recite the immense benefit which the nation has derived from the analogous agricultural experiment stations, and declare that the new class of stations would be equally valuable.

A Unique Mathematical Institution.—Prof. G. Mittag-Leffler, the Swedish mathematician, has recently announced the terms of a joint will made by his wife and himself, which provides for turning their villa at Djursholm, Sweden, into an institute devoted to the promotion of the study of pure mathematics, and furnishes funds for its maintenance. The endowment will also be available for rendering certain financial assistance to persons who show special aptitude for research in pure mathematics, and for bestowing prizes in the shape of medals and sets of the Acta Mathematica. The institute will contain the testator's valuable mathematical library.

Centigrade versus Fahrenheit Scale.— A committee of the National Academy of Sciences, consisting of Messrs. Abbot, Stratton and Marvin (the heads, respectively, of the Smithsonian Astrophysical Observatory, the Bureau of Standards and the Weather Bureau), appointed to consider the bill before Congress discontinuing the use of the Fahrenheit temperature scale in Government publications, reported at the last annual meeting of the academy in favor of the bill, but recommended two amendments. One of the latter provides that "when in the publication of tables containing several meteorological and climatic elements the use of data in centigrade temperatures leads to manifest incongruities, the Chief of the Weather Bureau is directed to publish related data in such units as are necessary to make the tables homogeneous and to secure international uniformity as far as practicable." The other amendment would authorize the use of the absolute centigrade scale.

The Problem of Ball Lightning, has not yet been solved, but there appears to have been some recent progress toward a solution. Dr. G. C. Simpson thus enumerates three significant characteristics of the phenomenon concerning which there is no longer much room for doubt: (1) The body or ball itself, which is able to retain its individuality as it moves through the air, appears to be composed of gas or matter in some novel luminous condition. (2) The balls appear to exist independently of any large electrical intensity, for they have been observed within closed rooms where large electrical fields are impossible, and have also been observed to pass in and out of parallel telegraph wires. (3) They appear to be associated directly or indirectly with large quantities of energy, for they have been observed to explode with violence and have also been seen to fuse the overhead wire of an electric railway. Dr. Simpson is inclined to connect the phenomenon of ball lightning with the fact discovered by Strutt that a mass of nitrogen can be put, by means of an electrical discharge, into a state in which it continues to glow for some time after being removed from the electrical field. Is not ball lightning a mass of some gas made to glow in this way by the intense discharge of a lightning flash? There are, at present, difficulties in the way of this explanation, but it seems to point out the direction in which further investigation of the subject should be carried on.

Radio Communication

Wireless to Supplement Cables.— It is reported that both Holland and Portugal are planning to establish wireless stations for insuring direct communication between the home countries and the colonies. The Holland government plans to erect powerful stations for establishing radio communication between the home country and the Dutch East Indies, while Portugal is planning an extensive system of stations for linking Lisbon with its colonies and other European capitals.

Radio Communication with Submarine Boats.— Many of the submarine boats employed by the European belligerents are equipped with wireless apparatus. In most instances telescopic or folding masts are used on the deck of the craft, for the purpose of elevating the antenna. When the craft is to be submerged, the masts, depending on their type, are either folded down or telescoped. Because of the necessarily low elevation of the aerial wires, the range of submarine apparatus is very limited.

Lagging Radio Time Signals.— According to the findings of the U. S. Naval Observatory, the time signals from the Arlington wireless station near Washington are found to lag about .02 second when received by the stations on the Isthmus of Panama. Time signals from the Key West station have a lag of about .27 second. In the case of the latter, however, the lag is due to the various relays in the commercial telegraph lines over which the signal passes from the Naval Observatory. As a general thing, the error in the time signals sent out by radio stations is less than 0.1 second.

The South San Francisco Station has had remarkable results with its 30-kilowatt arc transmitter. Messages have been copied on the typewriter on the S. S. "Ventura" of the Oceanic Steamship Company fleet, in daylight, at a distance of 3,830 miles; with pencil, in daylight and through heavy "static" or "strays," at 4,200 miles; and with pencil, in daylight, through "light static," at 5,140 miles. With the radio station at Tuckerton, N. J., using a 60-kilowatt Federal-Poulsen arc transmitter, the same vessel has copied messages by pencil in the early evening when 530 miles southwest of Samoa, approximately 8,000 miles from Tuckerton. This reception has often been duplicated, hence cannot be considered a "freak."

Wireless for Inter-Company Business.—The Kansas Gas and Electric Company of Wichita, Kansas, maintains a wireless station at that point and another at Independence. At present it is installing a third station at another of its branches at Pittsburg, also in the same state. The system is used three times a day, and officials report that it has effected an appreciable saving in the former telegraph and telephone expenses of the organization, in addition to forming a convenient means of daily communication between the closely allied branches. The wireless sets are operated by regular employees, who are simply required to spend the necessary half an hour or three quarters of an hour at each sending time, taking care of such messages as are to be sent or received.

Wireless on Motor Boats.—Although there are numerous motor boats fitted with both sending and receiving apparatus, many of them of less than 30 feet, it is doubtful indeed if the greater proportion of motor boat enthusiasts realize the advantages of such equipment. Primarily, a wireless receiving and sending set aboard a motor boat is a precautionary measure, for it is ready at all times to summon aid in case of disaster. But how about using the receiving set for copying the baseball scores, stock market reports, important news of the day, and a thousand and one other news items at any place the craft may be? Even with an inexpensive set, occupying but two cubic feet of space on board a boat, this is absolutely feasible. As a pastime, reading wireless messages excels.

The Recent Record Reception of the "Sierra," we are assured by the Federal Telegraph Company of San Francisco, was by no means due to "freak" conditions. The vessels of the Oceanic Steamship Company, of which the "Sierra" is one, are equipped with five kilowatt Federal-Poulsen arc transmitters for sending out undamped waves. The land station at San Francisco with which this particular communication was held is the South San Francisco station, normally used for regular trans-Pacific commercial work with Honolulu. It is equipped with a 30-kilowatt arc set similar to those adopted by the U. S. Navy. This station did not "pick up" the message from the steamship "Sierra," but the vessel had been in constant mutual communication with San Francisco up to that point and beyond. The position given, 4,870 miles from San Francisco, was that occupied previously by the vessel, and was sent direct in the usual routine of reports and commercial messages between vessels and stations, at 3:00 A.M. Pacific time. The range of the five-kilowatt ship radio sets, using undamped waves, has been found to be consistently well over 2,000 miles daylight transmission.

The diving hood in service in 20 feet of water. This photograph was taken by a submarine camera

Diver with his diving helmet removed, showing the freedom of action which the device permits

A trying ordeal for the diving hood: the wearer has deliberately upset himself without disturbing the hood

A Simple but Very Flexible Diving Equipment

By Robert G. Skerrett

THE latest thing in diving outfits is something quite revolutionary when judged by what has heretofore been considered absolutely necessary. Indeed, the new apparatus well-nigh completely upsets previous standards for under-water labor. To begin with, the veriest novice can use the gear without hesitation, and likewise without risk, and within submergences of 40 feet or less can render as useful service as an expert diver. Only one attendant is required, and his duty is that of working a lever pump that has capacity enough to supply air for a submergence to 50 feet. Should the man at the pump lag or the pump fail the diver is not endangered. He is not encased in a suit that holds him a prisoner. Instead, he has over his head and shoulders a metallic hood, which can be quickly lifted off and thrown aside. The helmet is not strapped to the wearer, but is held in place by four leaden weights which are just heavy enough to cause the hood to sink with a few pounds of negative buoyancy when filled with air.

The air supply enters the hood near the top of the cylindrical section, and when submerged the exhaust passes down and outboard through perforations near the bottom or collar. This supply and exhaust are absolutely automatic. There are no valves to be considered by the diver. As long as air at the proper pressure reaches the hood the exhaust passes out by way of the holes and effectually prevents the admission of water to the helmet. The downward direction of this circulation naturally carries out of the hood the exhaled heavy carbonic acid gas, and the wearer therefore always has fresh air to breathe. The modest dead weight of the device, acting against the buoyancy of the body, suffices to hold the hood so firmly in place upon the diver that it is possible for him to lie on the seabed without fear of losing his under-water headgear. A diver in a flexible suit could do this only by juggling his air and escape valves, and even then would run the very serious risk of having his suit inflated—something that would send him speedily to the surface, and might cause the bursting of his dress, if it did not imperil his life. In the front of the diving hood is a glazed port, through which the wearer looks when under water.

A complete outfit, consisting of the hood, a pump, and 50 feet of hose, is so compact that it can be stowed away in a chest 42 inches long and 15 inches square in cross-section. Hundreds of these outfits are now in service, and yachts, motor boats, and many kinds of commercial craft are being equipped with the apparatus. It is said that work can be done as easily at a depth of 30 feet as at the surface, and this by one not used to diving.

The simple performance involved in donning the diving hood

Of late, engineers engaged in subaqueous constructions have found the diving hood just the thing to enable them to go under water and to inspect the work themselves, instead of having to rely upon the reports of regular divers—men seldom fully qualified to pass judgment upon technical phases of such undertakings. The scientist, too, has called it to his aid in order that he might study aquatic life in Nature's setting. Wearing only the hood and a bathing suit, the man under water enjoys great freedom of movement.

A submersible which is designed after the description given in Jules Verne's "Twenty Thousand Leagues Under the Sea."

It will carry 30 to 40 men, and is equipped with a torpedo tube. Through hatches in its bottom, members of the crew can crawl out on the bottom of the ocean.

A Motion Picture Drama from the Ocean Bottom

By Loring Brent

WHEN Jules Verne wrote his novel "Twenty Thousand Leagues Under the Sea," a half-century ago, popular opinion of the time decreed that the idea was highly ingenious, but certainly not to be taken seriously. At a time when a large portion of Verne's predictions is coming true, it is interesting also to realize that his romantic story of the under sea is being recorded by the most modern of narrative forms—the moving picture.

Edwin and George Williamson, who made such startling revelations a few years ago with their undersea moving picture apparatus, have been working at Nassau, Jamaica, upon a new submarine picture. It has been their purpose to record upon motion picture film as many of the events of "Twenty Thousand Leagues Under the Sea" as their apparatus makes possible.

To those of the readers of the SCIENTIFIC AMERICAN who do not recall the description of the Williamson apparatus which was published in this journal when the Williamsons began their activities, an explanation of its operation will be interesting.

A heavy iron water-tight tube is suspended from the bottom of a sea barge. At the lower extremity of the tube is a large iron globe fitted on one side with a port hole, before which the motion picture camera is placed. While the apparatus can be effectively used at great depths, the film version of the present undersea story was made at about thirty-five feet under water. A greater depth was not advisable because of the fact that natural lighting was relied upon; also for the reason that the "movie" actors, who as deep sea divers were relatively inexperienced, would have had difficulties with the high pressure.

In the previous Williamson pictures of undersea life a cluster of electric lights was lowered in the water to provide sufficient illumination. Because of the crystal clearness of the sea in the neighborhood of Nassau, however, no necessity was found for artificial lighting.

It will be recalled that Verne's novel contains numerous encounters with sea monsters, as well as a generous use of a craft of the submersible type. When one of the leading American film producers had decided to transform the story into

a film, it was first concluded that a submarine should be borrowed from the United States Navy. But because of the lack of enthusiasm on the part of naval officials and the subsequent discovery that the craft described by Jules Verne was not similar to modern submersibles, the plan was discarded. It was then decided that a submarine be built especially for the picture.

Six months were consumed in constructing the submarine. When it was completed it would perform, with certain limitations, almost after the fashion of a naval submarine. It was found inadvisable to equip the craft with engines, but it was provided with compressed air tanks and inlet valves, by means of which it could be readily submerged and brought to the surface. It was also equipped with one torpedo tube which fired a regulation torpedo. While no explicit description of the submarine has been given out by the film company, it is known that the craft has a length, overall, of about 100 feet, a beam of 15 feet and a draft of 4 feet. It is not round, and consequently could not be used for diving to depths greater than 40 feet. Its deck is practically clear, with the exception of a short conning tower and one hatch for entering. A hatch is also provided in the bottom, so that the crew can crawl out upon the ocean bed.

The motion picture contains numerous scenes showing the submarine diving and rising. The film is made up chiefly, however, of scenes under the water showing the actors in their diving suits undergoing various exciting encounters with sharks and other monster fish.

Side view of the motion picture drama submarine which has been specially constructed for pictorial purposes
It is 100 feet long and engineless, and can be submerged by means of compressed air tanks to a depth of 30 feet.

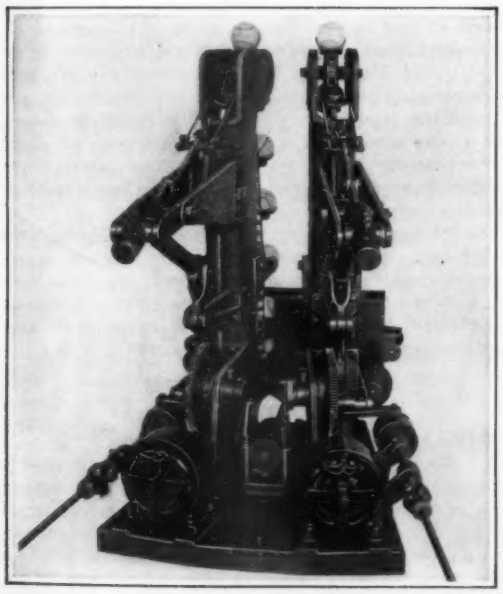
A great deal of difficulty was experienced by the undersea actors because of the aggressiveness of the Barracouta, a vicious tropical fish, which is slender, swift, and is armed with knife-like teeth. It was found almost impossible to drive the Barracouta off. The sharks, on the other hand, gave little trouble, as the divers discovered that they could easily be frightened away.

The picture, which has not yet been named, contains a number of thrilling moments. There are several hand-to-hand fights under water. There are numerous fights with sharks, and also a burial at the ocean bottom.

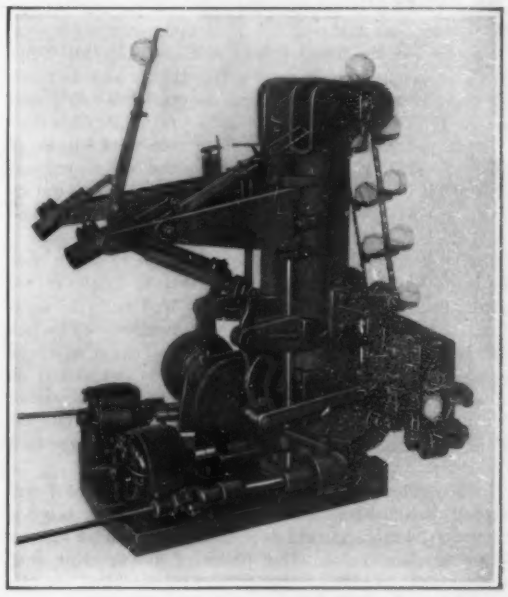
The work of the actor-divers was made comparatively easy, as their air supply was carried in oxygen-and-air tanks which were strapped to their backs. The tanks contained sufficient air and oxygen for approximately a thirty-minute stay under water.

The Williamson brothers had some difficulty in making the picture because of the occasional roughness of the sea and the swiftness of the tides. In a heavy sea the barge from which the Williamson tube was suspended would rock and the tube would swing, thus making the work of photographing quite impossible at times. It was also found highly important to carry on most of the photographing when the tide was either at flood or ebb. Several times attempts were made to film the divers when the tide was running, and on these occasions the divers were often swept from the range of the camera.

About one year has already been spent in the filming of Verne's story and it is not yet completed. More than 200,000 feet of film have already been exposed, and this figure is expected to increase to 300,000 before the work is completed. An idea of the arduousness of the moving picture director's task can be gained when it is mentioned that after he has labored to finish these 300,000 feet he must immediately begin the painstaking "boiling down" process. He must cut and piece the film so that its 300,000 feet of story are told in 10,000 feet or ten reels, this amount being sufficient, it is estimated, to fully entertain a motion picture audience for one evening.



Front view of the baseball pitching machine of the twin type An electric motor drives each unit



Side view of the baseball pitching machine, showing the chain conveyor and pitching arms

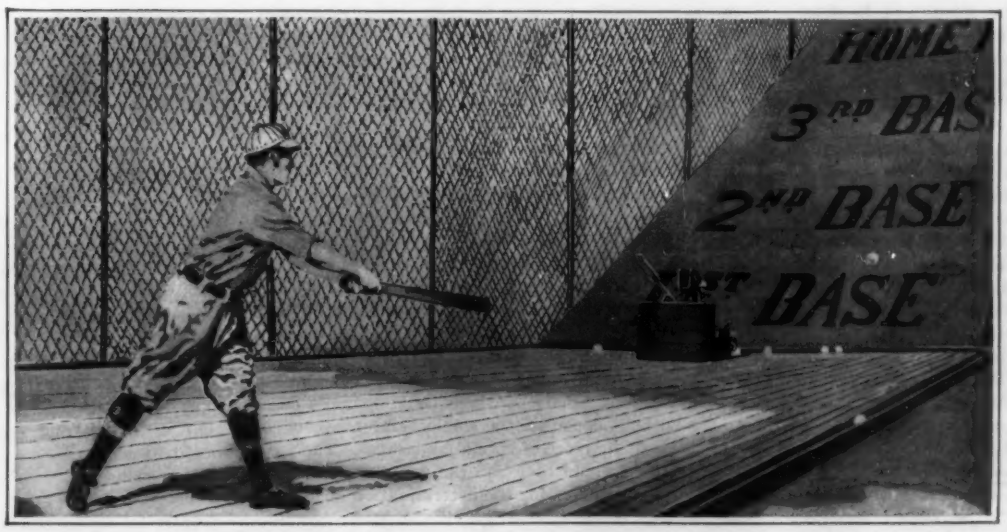
Baseball Batting Practice with an Automatic Pitching Machine

THE national game of the Americans, baseball, promises to be an all-year-round form of sport instead of being limited to the mild months of the year. The perfection of an ingenious, automatic pitching machine now makes possible the playing of baseball indoors, in a special form of court made of heavy wire netting. Thus the game can be played during the summer or winter, in daylight or at night, and irrespective of the weather outside.

Automatic baseball, which is the term applied to the new form of sport, comprises the batting part of the outdoor game—the crux of baseball. It is said to combine every feature that goes to make a great game, such as skill, strength, endurance, brains and steady nerves. The prime conditions of the outdoor game are emulated by the automatic pitching machine, which never throws two successive balls in the same way.

The new game, as previously stated, is played in a court made of heavy wire netting surrounding it on all sides and at the top. The network is held firmly in place by suitable iron framework. At one end of the court, the farthest from the entrance and the players, is placed an inclined board the full width of the court, and on this board are cross lines and lettering as shown in the accompanying drawing, indicating the success of each hit scored by the players. Some distance in front of the inclined board, on a center line, is installed the automatic pitching machine. The pitching machine and court can be arranged for one or two players; in the former case, the width of the court need not be greater than from 8 to 12 feet, while in the latter the width should be from 16 to 24 feet. The length of the court should be from 60 to 85 feet, with a height of from 12 to 16 feet.

Aside from the activities of the batters, the automatic baseball game is no misnomer. No one is required to feed the balls to the pitching machine; in the morning the balls are thrown into the court and the machinery from then on automatically performs its multitudinous functions. The operator in charge turns on the current to start the game, keeps the score for the players, and attends to the business phase.



How the game of automatic baseball is played
The player, acting as batter, hits the balls pitched by the automatic pitcher. The success of his hits is determined by an inclined, graduated board at the end of the wire-inclosed court.

The pitching machine will deliver 36 balls per minute, not every one in the same place, but varying the width of the plate and between the shoulders and knees just as in the actual outdoor game. The batted balls ultimately find their way to a trough at the rear of the pitching machine, from which they are picked up one by one by buckets mounted on an endless chain. The balls are then delivered singly to the pitching arm, the operation of which is under the control of the operator sitting in front of a score board at the entrance to the court. The pitching arms can be arranged at will for accommodating a right-hand or left-hand batter, while the

(Concluded on page 87)

Industrial Preparedness for Peace

Division of Labor in Chemical Research

By C. A. Jacobson

THE many sided character of industrial preparedness permits of unlimited discussion from many viewpoints. I propose to develop one of these which, while lucidly discussed on several occasions by gentlemen well qualified to speak, has yet escaped the attention of the preparedness propagandists, and of the public at large.

The value of chemical research to industry, to the army and to the navy cannot be gainsaid. The signs of the times point to a general awakening of the country to this circumstance. Chemical research laboratories are being established here and there, and the results already attained by such institutions, yet in their infancy, abundantly warrant further encouragement and support for this branch of science.

It is my thesis, however, that far higher efficiency could be attained, vastly more consequential results gotten, if the work could be so organized as to give each man a small share of a general problem, and to keep him at that particular work until he becomes proficient at it. We do not adequately realize the tremendous waste of time involved in becoming initiated into new fields of work and acquiring the technique of new forms and methods of manipulation. We have no general system of chemical research, we have but a mass of sporadic activity, among which are to be found numerous brilliant lights but whose work is as far from coordination as well may be.

Chemical research is at the basis of our industries, and determines the effectiveness of our military establishment. If judged by its importance to the country, it should rank highest in the scale of efficiency; but as a matter of fact the opposite is true. More money and energy are expended for a bit of information in this field than in almost any other conceivable form of activity. What is the reason for this? It is simply lack of organization, making it possible for work to be undertaken where adequate training for it is lacking.

No one can do many things and do them all well; very few people can do even a few things and do them all well; almost everybody can do only one thing and do it well. Upon the well established principle embodied in these premises is based our system of division of labor in industry, and it is likewise the key to success in almost every form of human effort. But unfortunately this key has not yet been used to unlock the door of the secrets of research chemistry.

In the good old test-tube days we used to think that the science of chemistry consisted largely in the clever manipulation of a few acids, bases and salts in solution. It is safe to say that the vast majority of people still hold this view; even a large proportion of those members of society whose education is calculated to make them somewhat conversant with the true situation think, when they speak of a chemist, of one who analyzes things, or, perchance, of one who compounds drugs in a pharmacy.

In general people have the idea that fixed rules and methods are at hand for the analysis of every material substance; that accurate determinations can be had by following these rules. If a bottle of ketsup were sent to a trained chemist for analysis of its chemical constituents, including spices, preservatives and coloring matters, it would be interesting to know what proportion of the American people would expect that he could produce these results within 24 hours. As a matter of fact, it is certainly a conservative statement that in order to obtain a correct analysis of this character, it would require ten such chemists, working continuously upon the problem for ten years, in the best equipped laboratory; and they would use up a carload of the ketsup.

If accurate analysis presents anything like the difficulties here indicated, some explanation regarding the results issued by food chemists would seem in order. Such results have merely relative value; in most cases their terms are ambiguous, and meaningless from the constitutional point of view. As examples, may be mentioned the official terms "ash," "insoluble solids," "volatile acids," "fats," "crude protein," etc. Terms of this sort are meaningless, for the reason that the composition of every one of the groups is entirely unknown, and will vary, not merely with every sample analyzed, but with the slightest change in the conditions under which the analysis is carried out.

Thus the term "ash" is supposed to cover the inorganic or mineral constituents present in the animal or plant structure before burning. But after burning, only a part of these are present, and almost never in the form in which they existed in the unburned material. Moreover, a variation of 100 deg. Cent. in the heat at which combustion takes place is expected, and frequently, in practice, the variation greatly exceeds this figure; and this is certain to affect the amount and character of the ash. Finally, the ash consists of compounds which in the presence of oxygen and oxides of carbon are far from stable at the temperatures involved, introducing another factor of uncertainty. Under the conditions mentioned these compounds are also more or less volatile. So the "ash" designation means very little. And the same is unfortunately true, to a greater or less degree, of several other standard determinations.

All this is said, not to disparage the value of the official methods—they are the best extant, and based upon the world's latest and most accurate work—but merely to point out the insufficiency along lines that are ordinarily regarded as very excellent, and to emphasize the need of more light, which embraces ardent and painstaking investigation. This cannot be carried out without an organized system of division of labor. It is too complex. Almost invariably successful research in one department of chemistry necessitates the application of such detailed knowledge in half a dozen other departments as can only be acquired by years of patient study. The investigator cannot stop to acquire it, if he is to finish his task; plainly the only sane method by which he can avail himself of it is to call upon the specialists in the fields in question. This constitutes the division of labor of which I speak; but it is a divison of labor, under existing conditions, which can be obtained only with great difficulty and frequently only at enormous expense. Perhaps I may illustrate the point from my own experience.

I have been engaged in a study of the fixation of atmospheric nitrogen by leguminous plants, and have chosen alfalfa as the most promising member of the family. The problem required a thorough chemical analysis of alfalfa, which was started six years ago, and is still far from completion. After working a year or so on the subject I found that a knowledge of the chemistry of chlorophyl was indispensable, and since there was no recognized chlorophyl expert in this country, I decided to go to Austria and there carry out this part of the project in conjunction with an authority on that subject. Then it turned out that the analysis of alfalfa with regard to the enzymes present could best be undertaken with the coöperation of a Swedish authority at Upsala, while for the protein analysis a German connection was necessary. And there are half a dozen outstanding phases of the investigation that await submission to a competent specialist.

What progress could not have been made on this problem if each phase of it could have been turned over to a properly trained man in the department concerned! But under existing conditions, I was able, at great expense and with great loss of time, to obtain an equivalent of the desired division of labor on a few sections only of this comprehensive problem.

I cannot too strongly emphasize the paramount importance, in the field of chemistry, of this division of labor. While some few restricted chemical investigations may be found demanding very little extraneous knowledge, no chemical problem of much consequence is so simple that several different methods of attack may not prove advantageous, or even indispensable. And no individual is capable of mastering, within a reasonable time, these several methods. If a chemist who has become expert in the field of vegetable proteins were to change to that of chlorophyl, it would in all probability take him two or three years, working alone, to become sufficiently familiar with the new department to be able to chronicle effective progress therein. Likewise a sugar chemist would know next to nothing about the chemistry of alkaloids, or a rubber chemist about alizarine dyes. So the only way in which may be achieved the results demanded by industry and war is by bringing to bear concerted action under competent direction. Then the unit of chemical work, if expressed in manpower-hours, would be more than doubled.

Let me amplify a bit further what I mean by this. Suppose a director of a large chemical research institution should require the ketsup analysis before mentioned. He would turn over a sample to each of his hundred or more departments for the qualitative determination of the presence or absence of the particular type of compound specialized in by the department concerned. There might be twenty-five positive reports. It would then devolve upon each department to make a quantitative determination, which could in most cases be done without consulting a single reference book or setting up a single piece of special apparatus. The purified compounds would then run the gauntlet of a series of special departments, for the determination of melting point, boiling point, specific gravity, electrical conductivity, index of refraction, optical rotation, combustion, crystal form and properties, solubility, colloidal properties, etc. In each of these departments, work should be constantly in progress upon representative problems within the scope of that department. There should be assistants in each department thoroughly familiar with its type of chemistry, who could devote part of their time to analysis and characterization of analogous compounds arising in connection with problems in other departments. In a word, it is the efficient factory organization I am pleading for.

What would be the cost of the first model of a new type of watch if made and assembled by a single workman? Suppose this workman were obliged to find suitable materials for each of the hundreds of parts, to decide what machines should best be used in their production, to learn to operate each of these, to design the external features, to master the art of gold-plating of the case, etc. Suppose that at each step he had complete facilities of equipment and access to reference libraries, but no expert help or direction whatever. Upon finally turning over his watch to his employers, he would be forunate indeed if it did not stop while the bookkeeper calculated how many thousands of dollars it had cost.

That this illustration is not overdrawn will be testified to by any one familiar with the work of the average chemical research laboratory. It is of daily occurrence to see a chemist spending hours reading up the literature or assembling the apparatus for a certain determination, according to a well established process. More than one capable assistant has spent a week in standardizing some reagent which could have been standardized in three or four hours by a specialist. The research chemist is often obliged to engage in pursuits other than those pertaining properly to chemistry, such as glass-blowing, draughting, typewriting, electrical installation, bookkeeping, routine laboratory work, and at times acting as substitute janitor. This is true of large as well as small laboratories, and European as well as American.

We have seen chemists wasting thirty or forty dollars worth of time and ten dollars' worth of material trying to make a piece of apparatus that could be made by an expert glass blower for about three dollars. We have seen chemists wasting ten dollars' worth of time on the typewriter, using the popular unidigital-hunt system, where the same work could have been done by a girl for seventy-five cents. We have seen five dollars' worth of time devoted to the reclaiming of fifty cents worth of some organic solvent.

Such things would not happen in a properly organized laboratory. As in industry and in war, the key to successful chemical research lies in well organized division of labor; and a government institution with many coördinated departments would seem to furnish the only satisfactory solution.

The Industrial Army

By Charles Fitzhugh Talman

THIS essay is a record of mental inertia.

The idea of the *industrial army* was suggested to me by a description[1] in *Die Woche*, from the masterly pen of Walter Bloem, of the stupendous achievements of the German army in rehabilitating the port of Antwerp after the retreating Belgians and British had done everything in their power to ruin it irretrievably. A corollary of Bloem's article, implied but not expressed, is the fact that a great modern army, by virtue of its discipline, coherence and selected personnel, is an agency ideally fitted for carrying out beneficent undertakings on a vast scale; and a further corollary, probably quite unsuspected by Bloem himself, is that such undertakings can and eventually must be made the normal business of an army when, during the long intervals of peace, it is not serving as an engine of destruction. I adverted briefly to this idea in an abstract of Bloem's article which I contributed to the *Review of Reviews* for May, 1915. Since that time I have acquired a rich fund of philosophy in fruitless attempts to interest American magazine editors in a detailed exposition of the same idea. Hence I speak advisedly of mental inertia.

Others have conceived and propounded the same idea with scarcely more notable results. In November, 1915, an organization known as the Society of Constructive Defense, domiciled at Ridgewood, N. J., published a pamphlet by Mr. H. G. Traver, entitled "Invincible America; a Plan of Constructive Defense." This work is so clear and cogent a description of the kind of army that a thrifty and enlightened democracy like ours ought to maintain—an army kept fully trained for war, but devoting the bulk of its energies in time of peace to useful public works—that I expected it to take the country by storm and immortalize its author. Nothing of the sort happened. To this day hardly the faintest echo of Traver's idea can be detected in the unremitting babel of discussion on the subject of national defense.

[1] "Vom Sterben und Wiedererstehen des Antwerpener Hafens," Die Woche (Berlin), Feb. 27, 1915, pp. 289-297.

In the *Congressional Record* of April 17, 1916, will be found the debate upon an amendment to the Army Bill, introduced by Senator Works of California, embodying a plan for a "constructive and military reserve force"; an idea originally suggested, a year previously, by Mr. G. H. Maxwell, in his interesting book, "Our National Defence." The Maxwell-Works plan, which I have not space to set forth here, seems to me conspicuously self-condemned by certain unpractical features; but these are by no means essential to its underlying idea, which is that of an industrialized army. On account of these features alone it was strongly disapproved by the War Department. Nevertheless, the Senators who took part in the debate on this amendment were obviously impressed with its possibilities. Senator Lane, of Oregon, frankly declared himself in favor of "putting the army at useful work—in the South in the draining of swamps, in the West in bringing water upon lands and making them fit for human habitation, and up and down and throughout the country in building military highways." It is superfluous to record that no trace of this revolutionary and admirable proposal is found in the Army Bill as passed.

The mental inertia which this fruitful idea has, thus far, failed to dispel in any measurable degree is the more amazing for the reason that the idea is already actually in operation in certain branches of our army. The most brilliant graduates of West Point are allotted to the Corps of Engineers. They are trained and ready for war—but they spend at least half of their army careers, on an average, in performing duties having no relation whatever to warfare! River and harbor improvements, the survey of the Great Lakes, and the construction of roads and bridges in the national parks are the subjects which almost monopolize the bulky annual reports of the Chief of Engineers. It was the officers of this corps who built the Panama Canal.

For twenty years—from 1870 to 1890—the Signal Corps of the Army maintained a national meteorological service (now the Weather Bureau), for the benefit of peaceful commerce and agriculture. To-day this same corps is operating the telegraph systems of Alaska and the Philippines.

If the Engineer Corps and the Signal Corps have thus been "industrialized"—made to pay for themselves, if not directly in money, at least indirectly in work of general utility to a nation at peace—why cannot the same plan be applied to the whole army? It can be, and, sooner or later, it will be.

The task of turning a recruit into a soldier consists of (1) teaching him the art of war, (2) imbuing him with the spirit of discipline, and (3) hardening him physically. Opinions differ as to the minimum amount of time necessary for the first of these three processes. The much-lauded Swiss system gives the infantry recruit 67 days of military training during his first year's service, and 13 days in each subsequent year until he passes into the reserve. The industrialized army, which would be a standing army, and not a militia, might give him, at convenient intervals, a total of six months' military training during a three-year term of enlistment, leaving him two and a half years to spend in industrial duties, under his own officers and under conditions of rigorous discipline. Thoroughly organized upon this basis the army would probably nearly or fully pay for itself, and *might be made as large as desired without imposing a serious burden upon the taxpayer.*

In both discipline and mobility the industrialized army would be far superior to a militia, such as that of Switzerland, and would not necessarily be inferior to a standing army of the traditional type. Lastly, the tasks of such an army could be chosen with a view to keeping the men out of doors, and in prime physical condition to endure the rigors of a campaign. In road-building alone there is enough vigorous open-air work to be done in this country to keep an army of half a million men busy for years; and such work could be dropped instantly if war broke out.

As to the officers, even now every army officer is supposed to be an engineer, and, as he is in the army for life, he has ample time to improve his talents in this direction without neglecting the unquestionably difficult profession of arms. Moreover, modern warfare itself is more engineering than anything else!

Intelligent "preparedness" consists, first, of preparedness for peace, which is the normal condition of a nation, and, second, of preparedness for war, which is an exceptional condition. The industrialized army is the embodiment of such preparedness.

I believe no more staggering example of mental inertia is to be found in the whole history of misguided humanity than the fact that, since standing armies came into vogue, the nations of the world have kept in their pay millions upon millions of stalwart workmen—enlisted nominally for the task of fighting, but having, for years and decades together, no fighting to do—and have never conceived the idea of setting them to work!

Correspondence

[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]

Patent Searches

To the Editor of the SCIENTIFIC AMERICAN:

Anyone entering for the first time the attorneys' room of the Patent Office would be surprised at the comparatively few attorneys who are engaged in making searches. Probably not more than one fifth or one tenth of the searchers are registered attorneys. Ninety per cent. are young clerks, hundreds of whom are employed constantly at this work. Occasionally one sees an inventor there, but only occasionally. And usually he is making his search under the guidance of some attorney. The searches would be better made and the specifications better written were the practice more universal of the attorneys doing their own searching. Any means of expediting the time required for the attorneys to complete the search would, it is believed, have this tendency. Many attorneys consider their time too valuable to waste any of it in searching numerous sub-classes, as at present is now oftentimes necessary. Were the attorney able at once to be sure of the proper sub-class, all danger would be avoided of wasting time. Were the work facilitated by furnishing in the attorneys' room a card index system of sub-classes similar to the card indexes in libraries, not only would the present waste of time be prevented, but the searches would be better made. By the use of such an index, the searcher could lay his hands as quickly on the proper sub-class as the librarian can now find the desired book.

Since there are more than fifteen thousand sub-classes, it is manifestly impossible for any one to be familiar with more than a small proportion. So the searcher, before making any search must, under the present arrangement, spend some time locating the proper sub-class. Indeed, oftentimes he makes mistakes which multiplies his work, causing him to search several sub-classes unnecessarily.

The card index would be of the greatest assistance in the case of inventions of well-known articles. It would not be so necessary in the highly technical classes where the searching is more likely to be done by experts. Who, for instance, would think offhand of looking for golf balls or motor tires under Class 157 Laminated Fabrics or mucilage bottles under Class 91 coating?

Under the present arrangement one is liable to make a mistake in looking up the sub-class of such a well-known article as a chair, which he would naturally expect to find included under furniture. Play houses and other simple well-known articles present similar difficulties. Carbon paper was a well-known puzzler. Any searcher, however experienced, could multiply instances of time wasted in finding the proper sub-class. Not long ago a manufacturer was caused a heavy loss by the failure of his attorney to make a correct report on the state of the art. The mistake was due to the failure to call the sub-class by the trade name. The art was japanning buckles, and the attorney believed that the state of the art was disclosed fully under japanning with heat. He knew that the buckles must be tumbled, but could find no sub-class of tumblers listed. He noticed a sub-class of rumbles, but as he was conversant with the commercial terms of the art and had never heard of rumbles, the attorney passed over that sub-class judging that it must belong to another art. It was only at the cost to the manufacturer of some thousands of dollars, that it was discovered that the Patent Office name for a tumbler was a rumble. Had there been a card index of common and trade names such a mistake would have not occurred.

It is probable that no card index will be installed unless Congress makes some specific appropriation for it. To be sure the expense would not be heavy, but the Patent Office has too much necessary work on hand to be able to undertake any extra work. For several years a clerk has been busy indexing patents, but there seems little chance that the work will be completed ahead of the completion of the work of reclassifying, which means not for many years more.

The *Patent Office Gazette* now gives the classification of each patent issued. As this has been the practice for five or six years, it would be comparatively simple to compile an index of patents issued during this time. Such an index, incomplete as it would be, would be much better than nothing. If such a one were installed in the attorneys' room it could be enlarged gradually and would, it is believed, in time, become as generally used and as great a necessity as the card index in the trade-mark division.

THEO. H. LOW.

New Haven, Conn., June 21, 1916.

Riverside Park and the Proposed Railroad Tunnel

To the Editor of the SCIENTIFIC AMERICAN:

Referring to the article, "Proposed Improvement of New York's Hudson River Front," in your issue of May 6th, may I call your attention to some misleading statements? If the finished work ever could be a realized fact the women of the city would not feel so keenly in giving over to commercial purposes our *last five* miles of river front. No money has been appropriated by the city—nor may ever be—and the $300,000 given, or to be given, by the railroad will not even meet the cost of "filling in." Instead of the present naturally beautiful park, the city for years will have an ugly cut, and if future city officials see fit to carry out the plan—and future citizens are willing to be taxed—there will be only *three feet* of earth in which no tree or shrub can be made to grow, hence the plan for gravel bridle paths and play grounds. Our city officials have no authority to give to any corporation the right to destroy park property, and as an organization we ask you to read the statements—made by men of knowledge—which I am forwarding—for, contrary to the last sentence in your statement, we feel that this is *one of the worst* propositions ever backed by city officials.

HELEN C. KERR.

The Woman's League for the Protection of Riverside Park, New York City.

A Rapid Way of Painting Screens

To the Editor of the SCIENTIFIC AMERICAN:

Your article in the SCIENTIFIC AMERICAN of April 1, 1916, in reference to finishing furniture with the use of compressed air gave me the idea of using a garden atomizer containing a quantity of green paint on window screens.

I first free the screens of dust and stack them against the fence, one behind the other, spraying the first screen, the back screens catching part of the fine spray.

After giving each a coat on both sides, I found the scheme worked to perfection, making the screen look like the new product and saving more than one half the time required by the use of the paint brush.

As this is the screen season, I thought perhaps it would interest your readers.

F. C. BARRY.

Washington, D. C.

Maple Sugar By-Products

To the Editor of the SCIENTIFIC AMERICAN:

I wish to call the attention of the readers of the SCIENTIFIC AMERICAN to a neglected phase of the maple sugar business. At present maple sap yields nothing except sugar, although it contains wood alcohol and many other things which might be obtained by distillation or chemical precipitation. One producer near here produced 10,000 pounds of sugar this year; the other products were wasted.

R. C. JONES.

Jefferson, N. Y.

The Current Supplement

IT will probably be rather startling to many, who have only the usual popular ideas in regard to the celestial bodies, to learn that, even now, when science appears to direct the world, very little is known about the sun, that great star that has interested man probably from the time of creation. To such, and to many others whose knowledge is much more extensive, the article on *Modern Views of the Sun*, in the current issue of the SCIENTIFIC AMERICAN SUPPLEMENT No. 2116 for July 22, will be most interesting and valuable. *The Zoological Gardens of Cincinnati* is another of the series of articles describing prominent institutions of this kind which have met with such an appreciative reception among our readers, and, as usual, it is elaborately illustrated. *Radiations from Exploding Atoms* adds another chapter to our knowledge of the newer physics, and it is illustrated by a number of diagrams. *The Evolution of Malleable Iron* tells something of the early practice in making malleable iron, and lessons learned by the microscope and scientific investigations. *The Corrosion of a Solid Solution* gives a great deal of information in relation to physical facts connected with copper-zinc alloys, alike of interest to the physicist and the technical man. *Hydrogenated Oils in the Soap Industry* tells of recent developments in an important industry. *A New Electrolytic Interrupter* gives detailed instructions how to make a very simple and efficient piece of apparatus that any experimenter in wireless problems can easily follow. It is accompanied by several excellent working drawings. *Photographing in Colors* gives the results of some investigations regarding the effects of the primary colors upon different photographic plates, which are illustrated by a number of reproductions of photographs. *Indian Hand Painted Calicoes* gives an interesting history of early Oriental fabrics, and describes the crude, but elaborate methods by which these noted products of the Far East were produced.

The officers and crew of the U-boat "Deutschland"

German Submersible Blockade Runner—"Deutschland"

Construction and Interior Arrangement of the First U-boat Merchantman

SOME few months ago, it occurred to some enterprising men in German shipping circles that if a large U-boat were constructed for the purpose of carrying cargo of a usually valuable character, it would be possible for such a boat to run the gauntlet of the British blockade and deliver her freight in some port of the United States with profit to her owners.

Judged from the standpoint of the naval architect and engineer, the construction of a boat capable of fulfilling the above conditions was a simple matter; even though it is true that in the military submarine, the extra weight which can be taken aboard is measured rather in pounds than in tons. Thus, several tons of cargo capacity would be gained by the elimination of the eight to a dozen torpedoes carried on the largest U-boats. Additional tons would be saved by the elimination of the rapid-fire guns for surface work and their ammunition supply. A further gain could be made by adopting a moderate speed, both for surface and submerged propulsion. The saving of weight in the smaller oil engines, smaller motors, and particularly in the reduced size of the batteries, would represent a very large addition to cargo capacity.

Evidently the thing could be done; and with characteristic enterprise a company was formed in Bremen and several large cargo-carrying U-boats were laid down. The first of these, the "Deutschland," left Bremen with a cargo of dyestuffs and chemicals on June 14th, and shaped her course for Heligoland. There, she remained for nine days, for the purpose, so her captain stated, of throwing the enemy off the scent, if, by any means, he should have learned of what was being attempted. "Deutschland" was manned by a crew of eight officers and twenty-one men. She was under the command of Captain Koenig.

Because of the dangers of the passage by way of the English Channel, which is netted and heavily patroled, Captain Koenig laid his course around the north of Scotland, and it was while he was in the North Sea that most of the submergence of the "Deutschland" (ninety miles in all) took place. Normally, the "Deutschland" would travel at the surface; but immediately on sighting any ship or ships that looked suspiciously like an enemy, the boat would submerge and run with only its periscopes above the surface; and if the situation became too risky even for periscopic observation, the "Deutschland" would be carried down entirely out of sight. According to the captain's account, on one occasion the boat was submerged to the bottom, and (in U-boat phraseology) went to sleep for several hours.

As will be seen from our photographs and drawings, the "Deutschland" conforms rather closely to the typical German naval U-boat. The hull proper consists of an internal, cigar-shaped, cylindrical structure, which extends from stem to stern, and in its largest diameter measures about twenty feet. Enclosing this hull is a lighter false hull, which is perforated, to permit the entrance and exit of the seawater, and is so shaped as to give the submarine a fairly good ship model for driving at high speed on the surface and at a much lesser speed submerged. The upper portion of the false hull does not present such a flat deck-like appearance as is noticeable in the naval U-boats. In fact, the whole modeling of the "Deutschland," as compared with the naval boats, suggests that she has been fulled out somewhat, with a view to obtaining the necessary displacement for cargo carrying.

Captain Paul Koenig

The interior cylindrical hull is divided by four transverse bulkheads into five separate water-tight compartments. Compartment No. 1, at the bow, contains the anchor cables and electric winches for handling the anchor; also general ship stores, and a certain amount of cargo. Compartment No. 2 is given up entirely to cargo. Compartment No. 3, which is considerably larger than any of the others, contains the living quarters of the officers and crew. At the after end of this compartment, and communicating with it, is the conning tower. Compartment No. 4 is given up entirely to cargo. Compartment No. 5 contains the propelling machinery, consisting of two heavy oil engines and two electric motors. The storage batteries are carried in the bottom of the boat, below the living compartment. For purposes of communication, a gangway, 2 feet 6 inches wide by 6 feet high, is built through each cargo compartment, thus rendering it possible for the crew to pass entirely from one end of the boat to the other.

The length of the "Deutschland" is about 315 feet; beam 30 feet, and draught 17 feet. For surface propulsion and for charging the batteries, the boat carries two 4-cylinder, Diesel, heavy-oil motors of about 600 horse-power each. The speed at the surface is from 12 to 13 knots; and submerged, it is 7 knots. At the surface the displacement of the boat is about 2,000 tons, and she has a cargo capacity of about 700 tons.

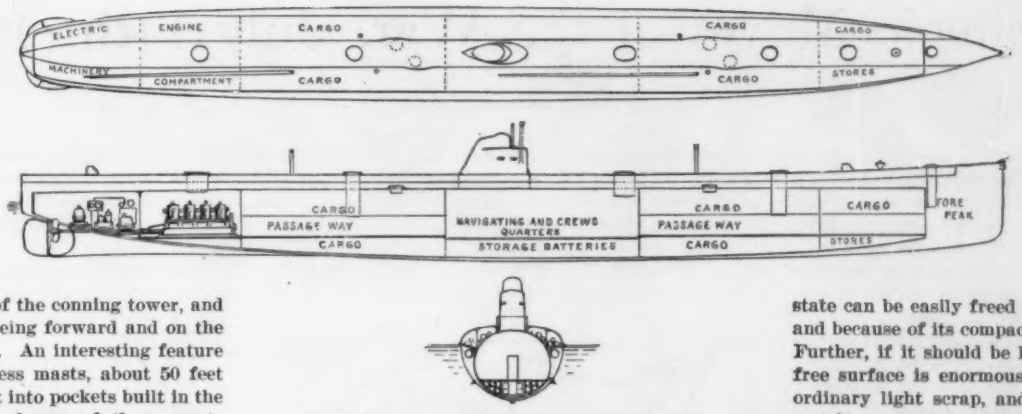
The freeboard to the main deck, which runs the full length of the boat, but is only about 5½ feet wide, is about 6 feet, and the

"Deutschland" from off the starboard bow

cockpit at the top of the conning tower is about 15 feet above the water. This cockpit, by the way, is suggestive of the protection afforded a chauffeur in an automobile, there being a shield in front of the quartermaster, so shaped as to throw the wind and spray upwards and clear of his face.

Two periscopes are provided; one at the forward end of the conning tower, and the other, of larger diameter, being forward and on the starboard of the conning tower. An interesting feature is the two folding, steel, wireless masts, about 50 feet in height, both of which fold aft into pockets built in the deck of the ship. The forward one of these masts carries a crowsnest for the lookout.

The "Deutschland" passed safely through the dangers of the North Sea, and once clear of the region of British patrols, she remained on the surface and made the trip across the Atlantic entirely at the surface. The weather was fair throughout. She submerged off the Virginia capes for a couple of hours, because of two ships of doubtful appearance. Once inside the capes, however, she made the trip to Baltimore entirely at the surface. She passed the capes on Sunday morning, July 9th, at 1 o'clock, and as she sailed from Heligoland on June 23rd, the time for the whole trip was 16 days. The total distance from Bremen to Baltimore over the course sailed was 3,800 miles. That the trip should have been made in that time and without the slightest mishap is a high tribute to the excellence of German naval U-boat and engine construction, and to the seamanship of her skipper and crew.



Plan and sectional views showing interior subdivision of boat

A Cutting Machine That Increases the Value of Light Metal Scrap

THE Germans have found out that they can very materially raise the market price of iron and steel scrap of certain sorts by cutting the stuff up into small bits. It is surprising how much money can be made or saved in this way, and the lesson is one that we can well afford to profit by. Under normal conditions, heavy melting scrap brings many more dollars a ton than light iron or steel scrap, and broadly stated this is because the light stuff takes up too much room from the time it leaves the factory or the machine shop until it is dumped into the furnace for remelting. This bulkiness imposes outlays and losses. Further, the light scrap is more expensive to handle in direct ratio to its lightness; and the temptation to place light scrap outdoors results in considerable deterioration of the metal.

Most of these drawbacks can be overcome by taking the turnings and borings as soon as they are made and cutting them up so that they can be stowed away in something like one tenth the space ordinarily required. Because of this compactness scrap so treated can be economically housed and sheltered from the weather, and it is infinitely easier to handle at every subsequent stage.

After something like six years of experimenting—most of it unsuccessful—R. Philipp, with the coöperation of two large concerns in Germany, has developed a thoroughly practical machine that is able to meet economically a wide range of service requirements. His cutter, by reason of its wide-mouthed hopper, can be charged freely and easily. The operator uses a pitchfork in feeding the smaller machine, and does not have to bother about foreign bodies that he may happen to pick up from the cluttered pile. In the case of the big cutter the scrap is dumped in by the carload and the ground product is carried away by mechanical transporters. The cutters are driven by small electric motors, and some of them are equipped with magnetic separators which isolate the iron and steel from other metals.

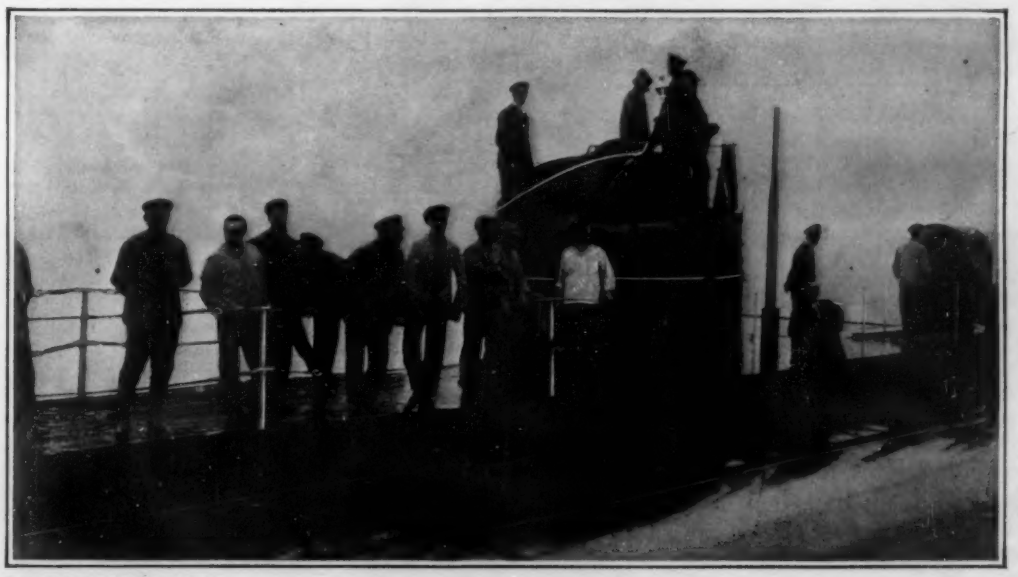
The cutters are made of high-speed steel; spare parts can be quickly substituted and are not fashioned with dimensional refinements; the cost of running and maintaining is a low one; and because the cutters are well-nigh foolproof they can be put in the charge of unskilled labor. All of this makes for economy, efficiency, and convenience, particularly where floor space and storage space are limited.

Fundamentally, the Philipp scrap cutter consists of a funnel-like hopper with tapering spiral recesses upon its inner surface, forming ribs and grooves, and a revolving spindle in the center with a corkscrew-like cutter. The natural tendency of spiral turnings is to grip around a shaft, and this characteristic is taken advantage of so as to draw the scrap to the spindle and to facilitate its downward passage. In this course, the scrap is broken and crushed between the spindle and the ribbed hopper, and finally merges in the form of small bits. This is not to be wondered at because, when the spindle is making 30 revolutions a minute, 4,800 cuts result from the passing surfaces of the cutter and the hopper.

One of the most ingenious features is that by which large foreign bodies are kept from getting down into the machine. Because of the form of the cutter and the nature of the ribs on the hopper at the upper end or mouth of the machine a mobile grid is produced which effectually keeps large objects out, or, rather, holds them there until the operator sees fit to remove them. Smaller bodies can work their way down, but in doing so the machine grinds them slowly and surely into small pieces without being itself in any way damaged. Scrap reduced to this state can be easily freed of oil by centrifugal wringers, and because of its compactness it gathers but little dust. Further, if it should be left in the open the amount of free surface is enormously reduced, as compared with ordinary light scrap, and therefore not apt to clog or mat by reason of oxidation.

Copyright International Film Service

Stern view showing the narrow central deck and the wireless masts



Copyright International Film Service

Near view of conning tower and navigating bridge

Metallized Ski-Blades

A REPORT comes from Davos, the famous Swiss winter-resort, of a new application of the well-known Schoop process of applying metals to various objects by means of a spray. A layer of aluminum, the thickness of a visiting card (about 1-10 millimeter), was thus applied to the bearing surface of skis. Not only does this render them far more durable, a feature of special importance in the sport known as ski-jöring (running on skis behind horses), but it greatly lessens friction, and also the tendency of snow to cake upon them so as to impede the progress of the runner. The diminished friction is said also to increase the possible length of a jump by several meters.

Increasing Popularity of Creosoted Wood Blocks for Flooring

CREOSOTED wood blocks, already extensively used as paving material for city streets, have been coming into use as flooring for the last four or five years, according to the Forest Service. The durability of this paving, its noiselessness under heavy traffic, and its sanitary properties are the chief advantages for paving and also give it particular value for making floors, especially for use where heavy trucking, the moving of heavy machinery, or other severe uses make the maintenance of floors a serious problem. Its rather high cost is its chief disadvantage.

Wood block is now widely used for flooring in factories, warehouses, machine shops, foundries, various types of platforms, wharves, and docks, and for such miscellaneous purposes as hotel kitchens, hospitals, laundries and slaughter houses. Possibly one of the oddest of these uses is for the floors of wild animal cages and runways. Notwithstanding the recent increase in the use of wood blocks for these purposes, it is believed that the growth of this industry will be even more rapid in the future. These floors are well liked by the workmen because they are easy on the feet.

Most of the blocks for these floors are now made of southern yellow pine. Hemlock, larch, Douglas fir, black gum, beech, and maple are also used. The blocks are sawed from long sticks of timber and are treated in huge steel cylinders from 6 to 7 feet in diameter and 100 feet or more in length. Creosote oil is run into the cylinders and pressure is then applied to force it into the wood. The oil is a product obtained in the manufacture of coke from coal and its purpose is to prevent decay of the wood, and also to prevent shrinking and swelling of the floor after it is laid.

The blocks are laid with the grain vertical, so that most wear-resistant surface is exposed, and usually on a concrete foundation. The joints or cracks between the blocks are then filled with hot paving pitch or asphalt which binds the many separated pieces into one continuous surface. According to the experts, the cost of creosoted wood-block floors averages about $1.50 per square yard for the blocks alone and about $2.40 per square yard for the completed floor.

For best results these floors should be laid under competent supervision, for unless certain fundamental rules are followed trouble is liable to ensue. Most of the trouble is caused by the swelling or the shrinking of the wood, due to changes in content of moisture, difficulties which may be guarded against, however, by carefully following the most approved methods.

Strategic Moves of the War, July 14th, 1916

By Our Military Expert

AT the moment of writing these lines, a situation partaking of the nature of temporary deadlock seems to obtain on both the western and the eastern fronts. In the sector of the allied offensive the week has seen the virtual straightening out of the salient which protruded from the German position into the Franco-British line at Mametz, while south of the Somme the French have pushed forward to Hill 97, an eminence which dominates Peronne, less than two miles away. There has been practically no lateral extension of the offensive front, the activities of the assailants having been given over to prosecution of the direct thrust upon Peronne and its railways.

On the eastern front the Teutons have been compelled by the development of the Russian thrust along the Lutsk salient, which has reached the lower Stokhod River, to abandon the Chartorysk salient and retire to the strong general line of this river. There was every likelihood that if retirement were not effected in time, farther Russian gains to the south would have practically isolated the Kaiser's forces in the salient south of the marshes; and while the men themselves might have been able to get out, their heavy guns and masses of stores would necessarily have to be abandoned. Discretion pointed the proper thing to do, and they took the measure.

The Russian forces in Bukovina have also slowed down. Whether this is due to the power of the hastily organized Austrian resistance, or whether it is a deliberate pause that the gains so far made may be consolidated and military loins be girded for renewed attack, remains to be seen; it is possible that there is an element of each in the situation.

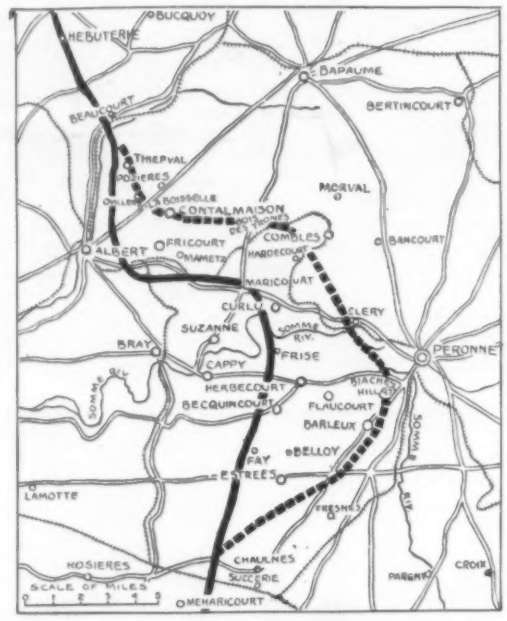
As it is, the Czar's armies in this sector have pushed well beyond Kolomea. The bulge where the present position has been gained, as compared to the old, is very marked. It begins in the vicinity of Buczacz, about 8 miles west of the town. Formerly, the Russian line was to eastward of Buczacz, and the town was taken during the general advance. From this point 8 miles to westward, the present line extends in a general southwesterly direction, passing west of Thumacz, then straddles the railway from Kolomea to Stanislau somewhat to the west of Michalkon. Farther to the southwest, the main railway from across the Carpathians to Stanislau—eventually to Lemberg and the entire line of communications system—has been cut at Delatyn. Twelve miles to the southward the Russians hold the station of Mikuliczyn on the railway, thereby putting a tremendous crimp into the Teutonic supply system in the sector. These latter stations are well within the foothills of the Carpathians, and the general line sweeps to the southeast, working toward control of the few passes in the mountain barrier.

A good idea of the method employed in the Russian drive, with demonstration of its objectives, may be had from comparison of the old line with the new. The center has remained comparatively inactive, while each flank—that is, of the section of the general line which is south of the Pripet marshes—has gained ground materially to the front, the horns of the crescent bending in as though to eventually inclose Lemberg, providing sufficient gains are made to reach that point. Lemberg, however, is but an important incident in the general campaign; a campaign always has as its ultimate objective the winning of a war, but many steps are necessary to secure this end. One such step is to be found as a possibility in the operations which have marked the advance of the northern flank; this particular section of the drive has two objectives instead of one: first, to aid in the isolation of Lemberg, with its important railway lines, and, second, the driving of a wedge between the main Austrian and German forces, to require the automatic retirement of the latter by a decided threat to the flank, communications and rear.

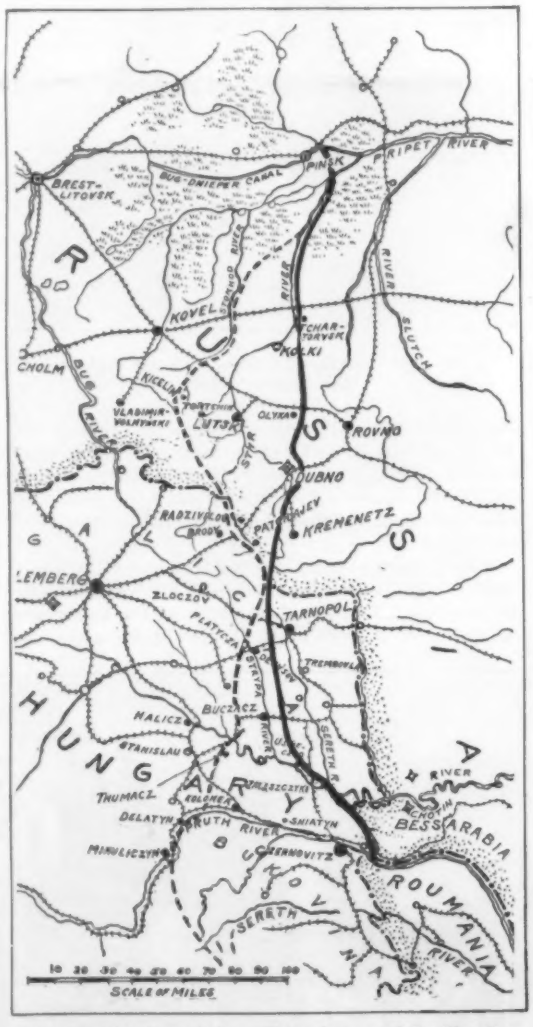
The lay of the land is especially favorable to the Russians here. The borders of the Pripet and the land contiguous thereto are a mass of broken water obstacles, marsh, mud, streams and lakes. These topographical features extend from just south of Pinsk, where the old line remains unmoved, westward as far as the river Bug. The land is easy to defend, and therefore forms such a reasonably secure point of rest for the right flank of the advancing Russians that they may almost with impunity ignore the danger of advancing from this point while the remainder of the great line to the northward is held in place; were it not for the topographical barrier of the Pripet, however, it would be but an invitation to defeat for such a movement to be attempted, for the right flank of the advance would be hopelessly exposed to attack, which would certainly come, if with nothing more available than a corporal's guard.

At the Stokhod the Russians seem to have been checked, whether for a short or a long time remains to be seen. Constant efforts have been made by them to effect passages over this stream, but so far only the most tenuous footholds have been gained.

The old saying, that there is nothing new under the sun, is exemplified in a newspaper report which tells how the Russians attempted to cross the river. The report erroneously claims that the movement is one newly developed; a mistake, for it was by the same method on a much larger scale that Napoleon Bonaparte effected his passage from the island of Lobau in the face of strong Austrian forces, and a French engineer received signal honors for devising the feat.



The Franco-British offensive
The heavy line shows the former front and the dotted line the advance up to July 14th.



The offensive in Galicia. The advance of the Russians and their original position shown by dotted and solid lines respectively

A long, strong pontoon bridge was built alongside the island, with the pivot end securely anchored. The length of the bridge had been calculated to a nice exactness, and when the moment was ripe, the swinging end was released, to be floated down by the current until the entire bridge swung squarely across the stream, when it was immediately anchored. Detachments were already on the bridge, and they charged across to the far bank, followed by the masses of the Emperor's troops.

The Russians have just employed the same method, on a smaller though more multiple scale. They are reported to have swung a dozen or more of such bridges in exactly the same manner, though without the same apparent success.

Strong troop movements from the Balkans have been reported within the last few days. Teutonic troops have been withdrawn to reinforce the Austrian front. The dispatches say that about three divisions—60,000 men—have been sent northward. Straws show the way the wind blows—sometimes; and if this report be true, it may indicate a great deal of interest. Let us figure it this way:

The Austrians withdrew strong forces from the Russian front and fell upon Italy in a splendidly organized offensive. Some say that their main effort was to cut off the forces along the Izonzo; others that the movement was instituted merely that the Teutonic allies might retain the initiative in the face of Entente preparations for assumption of the offensive; still others that the Austrians were endeavoring to prevent a sustained attack along the Izonzo, which matters seemed to indicate as imminent. At any rate, the Austrians weakened their Russian front—and Russia took advantage of the situation and cleared Bukovina.

Germany was involved at Verdun and, whether she might want to or not, was not allowed to break off operations. Kitchener's army massed behind the British line. The Germans knew it, and collected their forces north of the Somme; the French knew this, concentrated south of the Somme, struck—and gained more ground than the British did.

Teutonic troops are shifted from the Balkans, leaving some of their number, the entire Bulgarian strength divided between the Macedonian line and the Roumanian frontier, and certain Turkish forces, to handle the Balkan situation.

Now, does it seem likely, with the forces facing him diminished for the purpose of reinforcing elsewhere, that General Sarrail, with at least 600,000 men within the lines of Saloniki, will let such an opportunity pass? Does it seem likely that the Entente Military Council, that allied general staff which has at last managed to coördinate the action of the members of the alliance, will even permit the Saloniki armies to remain inactive? This is no prophecy, but merely a poring over the "dope-sheet" of past performances. Sarrail may not strike to-day or to-morrow, or next week; but as surely as anything can be, those 600,000 men are not being held in Macedonia to keep them out of war. They are there to strike at the most propitious moment, and it seems as though the moment were almost here. Roumania is to be reckoned with; perhaps negotiations are under way to induce her to throw in her lot with the Entente at once. If that be so, General Sarrail will necessarily hold his hand until his side can strike on two fronts. But it seems highly probable that within one month, at most, some of the most important dispatches of the day will be headed—"SALONIKI."

Preparation of Pure Iron and Iron-Carbon Alloys

A REPORT on the preparation of pure iron and iron-carbon alloys has been prepared by the United States Bureau of Standards, and is given in Scientific Paper No. 266 of the publications of that bureau.

It is shown that previous work on the iron-carbon diagram is unsatisfactory because of the great uncertainty of chemical composition of the materials used. It was therefore thought necessary to produce a series of alloys of great purity to form the basis of a redetermination of the diagram at the Bureau of Standards.

The general method pursued consisted in melting electrolytic iron with sugar carbon in magnesia crucibles. The electrolytic iron was prepared from ingot iron anodes in a chloride bath, with or without the use of porous cups. The operation of melting the iron with carbon gave great trouble at first, because the ingots obtained were full of blowholes and contained considerable quantities of impurities. The difficulties were overcome by melting in a vacuum furnace and making crucibles of especially pure magnesia made and calcined with great care at the Bureau of Standards. A satisfactory procedure was finally worked out and a series of alloys prepared, of the composition Fe + C = 99.96 per cent.

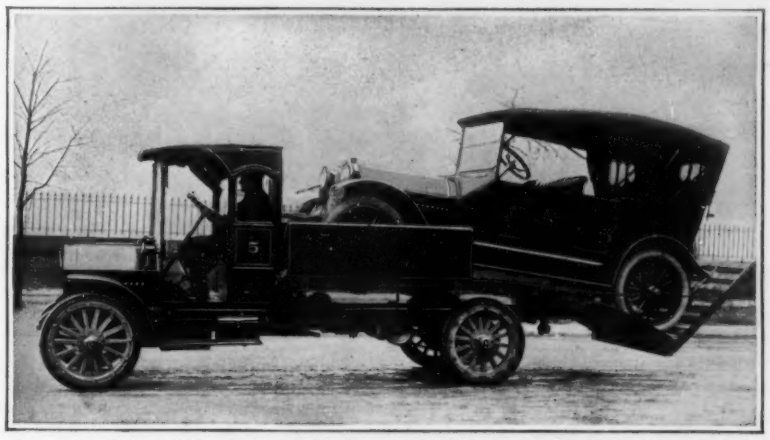
Inventions New and Interesting

Simple Patent Law; Patent Office News; Notes on Trademarks

A Novel Auto-Transporting Car

FOR the transportation of new cars and disabled cars, there has been developed a one and one half ton truck of special design. The truck, which is now in use in Chicago, is fitted with a 30 horse-power four-cylinder engine, and has a wheel-base of 144 inches.

The auto-carrying car is of exceptionally sturdy construction, as would be expected. The accompanying illustration depicts the manner in which a standard touring car is loaded on the truck and its extended platform, and how the car is prevented from falling off the truck by a back stop and heavy chains. To load the truck, the entire platform can be moved backwards and inclined.



Motor truck especially designed for the transportation of automobiles through the Chicago streets

An Iodine Wound Sterilizer

MEDICAL experience during the present war has established the fact that the vast percentage of the wounded may be saved if their injuries do not become infected before reaching either the field or the base hospital. The problem has been to provide the soldier with a handy and effective sterilizer that he could use himself. Of all the disinfectants tried for this purpose, iodine has proved the most effective even though decidedly painful when applied to an open hurt. Certain of the belligerents have furnished their men with little bottles of iodine and brushes for its application as part of their first-aid kit.

Unfortunately, these glass containers have very often been broken by reason of the rugged service required of the fighting man; and at times, when the bottle has been smashed by a missile, the bits of glass have been driven into the body gravely aggravating the nature of the injury. In short, the iodine has been lost just when it was most needed. To overcome these objections, Dr. Dreuw of Berlin has devised what he has called an "antiseptic cartridge," and one or more of these form a part of the first-aid packet of every German fighting man. This may possibly account for the extraordinary record of the Army Medical Corps of the Kaiser's armies and the exceptionally large percentage of wounded that are made fit for further service in the trenches or upon the battle field. The antiseptic cartridge prevents wound infection and enables the injured man, so long as he has one hand available, to paint his hurt or hurts with iodine immediately after receiving his injuries.

The cartridge proper consists of a metal cylinder of aluminum in which is placed a thin glass capsule filled with iodine. This is held in place by a plunger on top and an absorbent wick below. This constitutes a reasonable safeguard against breakage under normal service conditions. To make the iodine available for application the plunger is pressed down by the finger. This crushes the fragile glass capsule and releases the iodine which is promptly taken up by the wick. At the end of the wick there is a swab which serves the purpose of a brush, and as the iodine must pass through the wick to reach the swab it is impossible for bits of the glass to get into the wound. The cartridge is discarded after a single use. This prevents infection by transference from one person to another, as has been the case with the application of the iodine by means of a brush used possibly time after time and by several of the injured.

Iodine cartridge employed by German soldiers for sterilizing wounds

Pneumatic Rammers for Trench Tamping

WHEN trenches for pipe installation or repair are opened in paved streets, a most important item in the re-filling is the proper packing of the soil. If this is not done right up to the mark, hollows and washouts will eventually undermine the pavement and there will be a collapse.

Hand tamping is universally recognized as expensive and at the same time frequently inefficient. Hence it is well, where practicable, to perform this work by mechanical means. In recent work in the Borough of Bronx, New York city, pneumatic rammers have been used to good advantage. These are available wherever compressed air is to be had. They consume 28 cubic feet of free air per minute, at a gage pressure of 100 pounds per square inch. They may consequently be operated by a single man, who need not necessarily be a skilled laborer. No great amount of care is necessary to keep them in order, aside from cleaning and oiling.

The contractors on this operation state that the cost of operating the pneumatic rammer is about one third that of hand tamping, and that the work is much more satisfactorily done. With three men shoveling and six tamping machines in operation, a 50-foot section of trench, 20 inches wide and 2 feet deep, was completely filled in one hour. The work cost $1.80, or 28 cents per cubic yard, and the ratio of tampers to shovelers was high enough to insure good tamping. Frequent tests have established the cost of tamping alone with this machine to be about 7 cents per cubic yard.

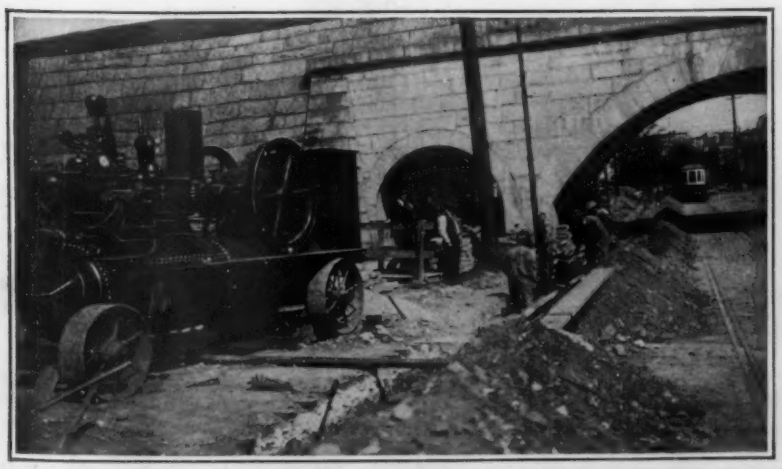
A Copper Mine in a Museum

Interesting Exhibit Just Opened to Public at Washington

VISITORS to the United States National Museum at Washington are expressing much interest in the new copper mine exhibit recently installed by the Division of Mineral Technology. This exhibit consists of an abandoned working from a large Arizona mine. It is in no sense a model, but an actual piece of the real mine, removed bodily from its original setting to a room in the museum building—ore faces, timbering, chutes, and all. As the visitor passes through the entrance into the museum mine, he finds himself to all intents and purposes in exactly the surroundings in which he would be placed were he to enter the mine cage at Bisbee, and descend the shaft hundreds of feet to the working level and enter one of the headings.

The stope in the museum forms a room-like structure, with a roof of heavy planks, walled in on two sides by solid ore, on a third by broken ore held in place by a lagging of timbers, and on the fourth by barren rock forming the boundary wall of the vein. To the left is seen the working face of the ore where it is being drilled and blasted loose. Set up and ready for use, there stands a compressed air machine drill, together with the picks and shovels left by the miners, who have apparently just quit work. On the right is located the plank-walled chute into which the broken ore is shoveled, and alongside it the manway, with a ladder by which the workers gain access to the stope from above or below. Here also run the air pipes for operating the drills, and through these passages is forced the fresh air to the miners on the working levels.

Altogether, a keen sense of reality is felt, even by those familiar with mining operations. There, in a corner, hang a miner's jacket, dinner-pail and lamp, while below, against the timbers, lean his tools. The timbers themselves tell a tale also; they are scarred and pitted with the many explosions and blasts set off to loosen the ore, and small pieces of the latter are seen imbedded in the wood, where they have been hurled by the force of the detonations.



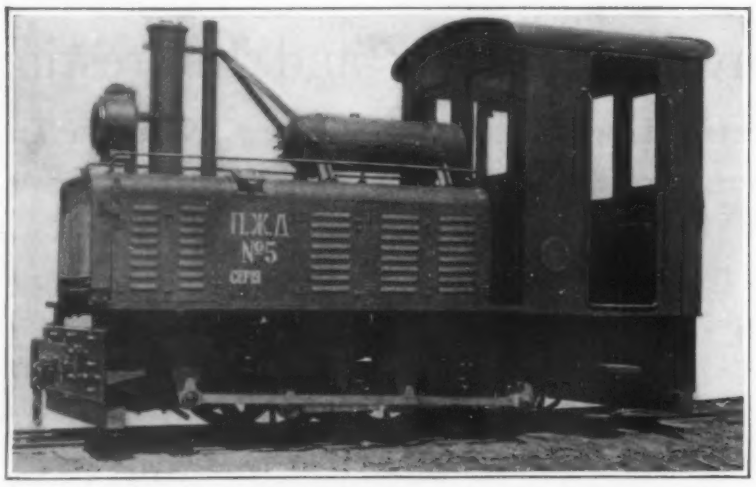
Portable air compressor used in supplying motive power to pneumatic rammers for trench tamping

Workman using a pneumatic rammer for tamping the dirt in a street trench in the Bronx, New York City

Gasolene Locomotives for the Trenches

DAILY we are made to realize more and more that the war in Europe is a machine-made struggle. The human factor counts at the ultimate moment, but up to that point mechanical contrivances of an endless variety break the ground or lay the foundation for the final outcome. Another proof of this was given recently in an order from the Russian Government to one of the large American locomotive works. The Imperial authorities have contracted for the construction here of 350 gasolene locomotives, and these engines are to do the hauling on certain narrow-gage lines.

Naturally, the Russian officials have not told the builders just where these novel locomotives are to do their work, but as they are described as "trench engines" it is evident that they are to do the transportation work from military bases right up to the advanced positions. All of these engines will not be sent to a single front. Half of the number will go to one strategic point and the other 175 to another seat of military operations.



Gasolene locomotive for trunk railroads supplied the Russian government by an American concern

The gasolene locomotive has certain economical features that strongly commend it for special lines of work, and it undoubtedly fits particularly well into the environment of a theater of war remote from ordinary lines of travel and convenient supplies of coal. In other words, the gasolene locomotive is a mechanical counterpart of the traditional army mule—very serviceable and able to perform well despite hard usage and a rough roadway.

These locomotives are the outcome of several years of successful service and gradual improvement. Heretofore, such tractors have been employed in contracting operations, about quarries, on plantations, at lumber-mills, around smelting plants, etc., and have fully demonstrated their special fitness in these fields. It is just this sort of varied work which the exigencies of trench warfare impose; and the gasolene locomotive has some decided advantages over the motor truck at such a time, even though it must travel along rails.

As experience has proved, in industrial applications, the gasolene locomotive is safe, efficient, clean, and quite independent of external sources of power. So long as its fuel tank has anything in it the engine can be counted upon to respond to any reasonable demand, and, therefore, its radius of operation is limited only by the capacity of the tank. It is of especial value as a tractor in localities where water is scarce or coal inaccessible.

Approximately, each of these locomotives weighs about 7 tons and is designed to run upon narrow-gage lines having a span of 29½ inches. The dimensions in some other directions differ slightly from the standard make in order to meet the particular requirements of the Russian Government. The motor for each locomotive has four cylinders operating upon the four-cycle principle. The diameter of the pistons is 5½ inches with a 7-inch stroke, and the engine is started by hand. The main or fly-wheel clutch is of the multiple-disk, bronze-and-steel type.

The motor is required to run successfully upon gasolene having a specific gravity of .77. The transmission is such that it provides speeds of from 4 to 8 miles per hour on the low and the high gear, respectively, on both forward and reverse. The engines are water cooled. The radiator is substantially constructed and has an unusually large surface and water capacity. The generous proportions prevent overheating when the engine is developing full power under the most severe hauling conditions. A constant circulation of air is maintained by a fan driven from the engine.

The fuel tanks are of seamless drawn steel, and are tested to a pressure of 300 pounds per square inch. These tanks are located over the hood which makes it possible for the fuel to feed by gravity to the carbureter. Accordingly, there is very little pressure in the feed pipe, and the likelihood of leakage in the connections is reduced to a minimum. These points all make for robustness and ability to stand up under rugged service. Perhaps one of the most valuable features from a military standpoint is the manner in which the exhaust is taken care of. This is led to a large muffler. This device allows the gases to expand, and this is so generously effected that the final blast is hardly noticeable.

When running at the normal or rated load, the consumption of gasolene is about one tenth of a gallon per horse-power per hour. This draw-bar pull, with high gear and on level track, is substantially 1,500 pounds, and this means the capacity to handle very considerable loads under trying conditions. For instance, allowing for a resistance of 50 pounds per ton, one of these 15,000-pound locomotives will be able to handle 30 tons of munitions, food, or other military supplies at a single load.

Railroading has played a conspicuous part in the military operations up to date, and more than once success has been due to field railways and their skillful maintenance. The gasolene locomotive brings to the service a new element, but one that has already done excellent work under no less exacting conditions. This is another of America's distinctive contributions to the prosecution of modern warfare.

Electric oil-well motor with "butterfly" connection to second well

Two Electric Motors in One for Oil Wells

By Irwin B. Smith

CONDITIONS in the oil fields greatly favor electric operation of the wells. In every field a large number of wells must be sunk and each well must be supplied with power; but the distribution of this power presents many difficulties when steam or gas engines are used. In some cases a central steam boiler delivers steam through pipes to the various wells; in others a central engine operates a heavy wooden frame, called a "butterfly," to which a number of rods are attached, each rod running to a well and driving the machinery. Such methods are obviously crude, awkward, and inefficient as compared with the electric distribution of power. The characteristics of the motor—its reliability, ease of control, wide range of speed variation, indifference to extreme cold, and other advantages—also commend it to this service.

But when electrical engineers began to study oil wells for the purpose of designing a suitable motor to operate them, they discovered that they had a puzzling problem to solve, for oil wells have very unusual power requirements. Briefly, the essential mechanism at an oil well is a heavy wooden walking beam operated by a large pulley, to which the motive power is belted. This beam raises and drops the drill by which the well is sunk and also operates the pump for removing the oil. These two operations require comparatively little power. But the engine or motor is also called upon to pull out the drill, pump, and cleaning tools, often from depths of many hundred feet, and also at times even the tubing with which the well is lined; for these purposes much greater power and, especially, a strong initial pull are needed. It is a simple matter to install a motor large enough to handle the heaviest work, but such a motor would be high in first cost and would be very inefficient for normal drilling and pumping because it would then be operating on but a fraction of its rated load. The problem was, therefore to design a motor that would be efficient on light loads and would be capable of extremely heavy pulls for short periods.

The type of motor which satisfied these conditions is practically two motors in one. Its most conspicuous feature is a large knife-switch mounted on the frame. When this switch is in one position the three-phase windings of the motor are connected in the so-called "star" arrangement (Y), and when it is in the other position the windings are "delta" (△)-connected. Without going into the technical details, a motor that can develop 10 horse-power continuously with star-connected windings can, with delta-connected windings, develop 30 horse-power for a short period without injury and can give momentary pulls equivalent to about 85 horse-power. With either connection the efficiency is satisfactory. This somewhat novel machine solved the problem effectively and opened the way to the electrification of the oil fields.

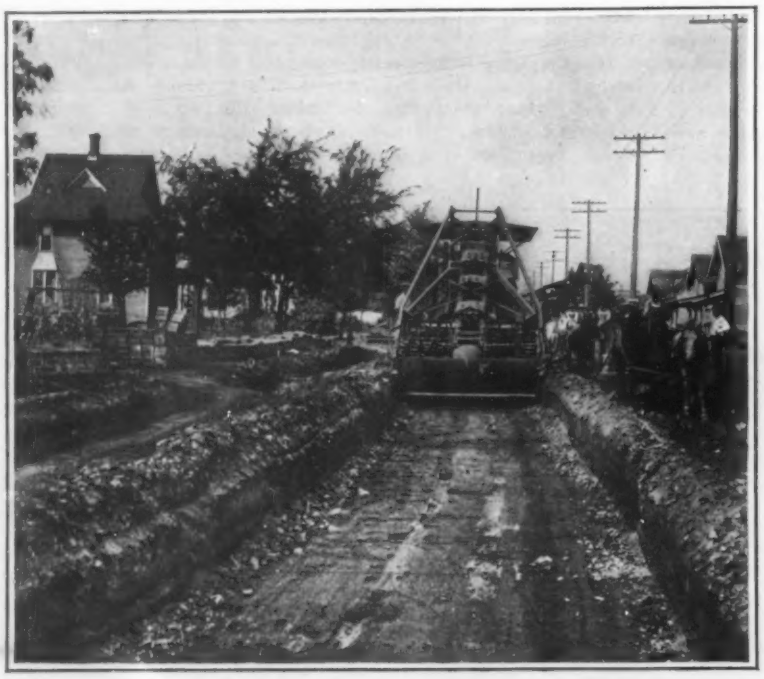
A Machine That Does the Work of Many Laborers in Grading and Excavating Work

THERE has been developed at Rockboro, Ill., a grading and excavating machine for municipal street work. It is especially adapted to grading in connection with street paving work wherein it is desirable or necessary to haul the dirt in dump wagons and where space is limited.

The new machine, which is also adapted to the excavating of trenches for street railway tracks, cuts a strip 8½ feet wide, and will excavate 2 or 3 inches deep, or as deep as 5½ feet deep if necessary. The cutting wheel, working on a boom, is instantly adjustable by a screw which raises or lowers it; and an indicator is provided in order that the operator can run true to the grade line. The earth taken out is deposited in the dump wagons; and the production is said to be so uniform that the number of teams required for each day's work can be determined to a nicety by the length of the haul. So accurately can this be done that there will not be over half a minute lost team time at the machine on each trip, which is obviously a great point in favor of the machine.

It is stated that the new machine can be operated so as to cut very close to a finished fine grade, saving a considerable amount of expensive hand work. In practice it is found best to make the outside cuts on street work first, cutting to a line that allows room for the curb and gutter and the forms. On the outside cuts the excavator is pitched to conform to the crown of the street. If the width of the excavation should be 25½ feet, there would be two outside cuts and a middle cut. If the width of the excavation were

(Concluded on page 87)



Excavating machine at work on a trench for street railway tracks

Annual Subscription Rates for the Scientific American Publications

Subscription one year $3.00
Postage prepaid in United States and possessions, Mexico, Cuba and Panama.
Subscriptions for Foreign Countries, one year, postage prepaid $4.50
Subscriptions for Canada, postage prepaid 3.75

The Scientific American Publications

Scientific American (established 1845) $3.00
Scientific American Supplement (established 1876) 5.00
The combined subscription rates and rates to foreign countries, including Canada, will be furnished upon application.
Remit by postal or express money order, bank draft or check.

A Machine That Does the Work of Many Laborers in Grading and Excavating Work

(*Concluded from page 86*)

less than 25½ feet, the result would be the same. On the other hand, if the width of the excavation were 27½ feet, for instance, there would be 2 feet of the side which could not be handled through the machine. However, this extra material is taken care of by making the center cut as before, and sufficiently deep so that the foot of surplus material on each side of this cut can be leveled down and rolled into the center cut. In practice it has been found desirable to cut slightly below the finished sub-grade, and at the last cut to finish the fine grade at once by dumping sufficient material from the wagons to level it up to the desired grade and immediately roll. Obviously, this is much less work than making a fine grade by removing the surface with hand tools.

It will be noted that the material at alley intersections is taken care of by excavating deeper in front of the intersection for from 16 to 24 feet, and then to plow the intersection and slip the earth into the extra depth.

The new machine will work on old macadam streets if the excavation can be made 2 inches. It is seldom necessary to root or plow the streets in advance of the machine as the cutting drum is provided with narrow, sharp cutting teeth; and the machine is also prepared to handle sand and other fine material.

It is pointed out that in street railway track excavation, the track trench is usually from 18 to 20 inches deep, and 8½ feet wide. This cut is made in one operation with the excavating machine and the spoil put in wagons. If the work is the reconstruction of railway track, the track may be removed closely ahead of the machine by jacks, and the trench behind the machine suitably filled in and new track laid down, close behind the excavator. In fact, so accurately can the work be gaged that in the instance of a single track undertaking the cars can be kept running with only a break and transfer of from 150 to 200 feet. About 500 lineal feet of track trench can be handled in a 10-hour day.

Baseball Batting Practice with an Automatic Pitching Machine

(*Concluded from page 79*)

operator can vary the speed of the pitched ball by the simple manipulation of a lever placed within convenient reach of his seat. In actual operation a sufficient supply of balls is provided for some storage and for filling all of the buckets which are ever in action at one time. The pitching machine is driven by electric motors, one for each pitching arm, through suitable reducing gears to convert high speed into power and low speed. Each motor is so regulated and the parts of the machine are so proportioned that the balls are thrown at sufficiently long intervals to suit the convenience of the batter. Furthermore, it is possible to operate either one or both pitchers on the twin-pitcher type, independently of each other, and to feed the balls twice as fast when both pitchers are operating as when one pitcher is operating.

Those who have played the game of automatic baseball state that it offers the same element of excitement as the outdoor form and that, strangely enough, the spectators enjoy it quite as much. The batter is always the center of interest in the new game, and upon his ability to hit the ball and place his hits depends the success of his team, just as in the original game. The placing of hits, singles, doubles, three baggers or a home run, is registered by the score keeper, according to the batter's ability to place his hits in the designated spaces on the graduated canvas field. It is strictly a game of skill, and regulation baseballs and bats are used. The game can be played by single players or by teams, as the case may be.

RECENTLY PATENTED INVENTIONS

These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN.

Electrical Devices

AUTOMATIC ALARM FOR SPRINKLER SYSTEMS.—L. A. GRIMES, 97 Day St., Orange, N. J. The invention has particular reference to automatic sprinkling systems for the protection of buildings from fire. It provides connections for a water or other fluid pipe, whereby an alarm may be given to the superintendent or other official at any distant place when there is an abnormal flow or other condition of the fluid in such pipe.

CABLE INSULATION STRIPPER.—A. A. PEHRSON, 163 E. 37th St., New York, N. Y. This invention relates to an implement adapted to be used by electricians, linemen, telephone switch-board installers, and others, for the purpose of cutting the covering or insulation of a cable or circuit wire, and the invention improves the construction of devices of this character so designed that the covering of a cable or wire can be easily and quickly cut without danger to the insulation on the individual wires or of the user cutting himself.

RHEOSTAT.—A. J. ARCH, care of W. Kaufman, 7 Beekman St., New York, N. Y. The present invention relates to rheostats especially adapted for treatments by the cataphoresis and ionization methods. It improves the construction and operation of rheostats and is so designed as to enable very fine adjustments for small variations in current strength.

TROLLEY GUARD.—C. M. SWEDBERG, 30 Willow Place, Yonkers, N. Y. This invention improves and simplifies the construction of trolley wheel retainers so as to be reliable and efficient in use, comparatively simple and inexpensive to manufacture, and so designed that the wheel can be easily disengaged from the wire when desired, or returned to the latter.

Of Interest to Farmers

CREAM GAGE.—E. R. ROBINSON, 934 Spruce St., Wilmington, Del. In this invention a stand supports a bottle in an upright position. Gage fingers are separately adjustable under the influence of adjusting screws to position the gages relative to each other and to the neck of the milk bottle. The fingers and their operating screws are mounted on a carriage adapted to be bodily adjusted or to be swung to or from the position of the bottle. On the stand is a swinging frame carrying a magnifying glass whereby said glass may be swung in front of the graduated neck of the bottle, or swung away from the bottle.

POULTRY HOUSE.—C. C. MOORE and G. W. MOORE, Unadilla, N. Y. This invention provides a house with a flooring structure which may be adjusted in order to properly accommodate the brood of poultry during any part of its life. It provides a round house arranged with light and ventilating openings whereby a sanitary, dry and comfortable house is provided at all times without excessive draft.

COVER FOR SAP BUCKETS.—F. E. KINNEY, Jericho, Vt. The inventor provides a cover that will permit of the buckets being nested without separately packing the covers; provides a cover attachable to various forms of sap buckets whether the latter are used with a sap spout entering laterally through the side of the bucket, or with a spout on which the buckets are hung so that the rim of the bucket will be below the spout; provides a bucket having a hinged connection that will permit the cover to be suspended on the bucket at the outside thereof in a substantially vertical position with the bottom of the cover above the bottom of the bucket; and provides means to indicate that the bucket is emptied or to be emptied.

Of General Interest

PEN GAGE.—J. H. SPENCER, Box 74, Tutwiler, Miss. The inventor provides a gage for use in ink stands of any character, and arranged to limit the dipping movement of the pen in the ink and in the stand, and wherein the gage is mounted in such manner that it may be adjusted to suit conditions, with respect to the stand.

HYPODERMIC STERILIZER.—A. OWEN, care of Kress & Owen Co., 361 Pearl St., New York, N. Y. This improvement has reference to a sterilizing device and has for an object to provide a simple effective arrangement whereby unused needles may be continually maintained in a sterilized condition, while one that is in use may be readily sterilized.

MATCH BOX AND CIGAR CUTTER.—E. OLDENBUSCH, 366 Butler St., Brooklyn, New York, N. Y. This improvement relates to a combined match box and cigar cutter and provides an arrangement whereby a package of matches is held properly in position and properly protected while certain parts of the device may be utilized for cutting and severing the end of the cigar.

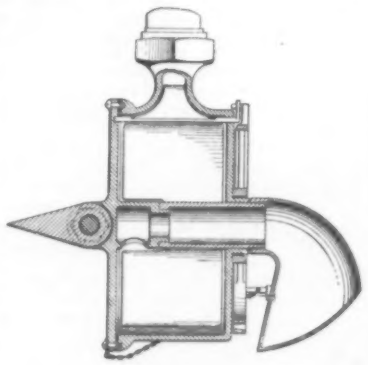
BACKBONE COVER ATTACHMENT FOR BOOKS.—J. R. POPE, 527 5th Ave., New York, N. Y. The object here is to cover the backbone of a book where a new or different backbone, for whatever reason, is desired and in particular to provide a means for any one to economically, quickly and easily cover the backbone of a book with a binding in material, design and color according to their liking, and thereby secure in a library or shelf individual or uniform effects of book bindings, effects of handsome bindings on inferior bound books or bound pamphlets, etc., and effects of uniformity, order and neatness in book shelves and libraries.

Hardware and Tools

BRUSH HANDLE.—ALICE W. SWAYNE, 221 South Union St., Kennett Square, Pa. This invention provides a handle having telescopic sections, one of which is provided with a plurality of threaded portions spaced apart with any one of which a threaded portion on the other section is adapted to mesh so that one of the sections may be extended as desired relatively to the other section and a threaded portion may be brought to a position where it will mesh with a threaded portion on the other section and may be turned relatively thereto to secure the section together in adjusted position.

LOCK.—L. W. HOLLAND, Pleasant Hill, Mo. The object of the invention is to provide a lock which may be used with automobile doors or doors of buildings or other structures, and which is provided with means for holding the door rigidly in its closed position so as to prevent rattling.

LAWN SPRINKLER.—K. NOMIYA, 2119 Haste St., Berkeley, Cal. This invention relates to lawn sprinklers of the revolving type. It provides a sprinkler which may revolve continuously in one direction or which may be caused to revolve forth and back through predetermined angular distances. The sprinkler head is so arranged that it will deliver substantially the same amount of water near the sprinkling head as at a distance therefrom. It can be placed at different inclinations to the ground to be sprinkled.



LAWN SPRINKLER.

MULTIPLE WRENCH.—L. KALINA, 384 Alabama Ave., New York, N. Y. The invention provides a wrench arranged to provide a number of differently sized wrench heads, any one of which can be readily brought into position for engagement with a nut or similar article whether the same is visible or not, and to allow of folding the wrench into a comparatively small bundle when not in use, thus rendering it exceedingly serviceable for the use of mechanics, drivers of automobiles and other persons.

METHOD OF OPENING HARD OR FROZEN TAPPING HOLES.—H. C. WITZ, 212 Morgan Place, Johnstown, Pa. In the present patent the invention has reference generally to blast furnaces, open hearth furnaces, and the like, and more particularly to the tapping holes thereof, and aims to provide a simple, quick and effective method of opening hard or frozen tapping holes.

Household Utilities

COMBINATION FOLDING COT.—G. A. FANJOY, 531 Bay View Ave., Freeport, L. I., N. Y. This improvement relates particularly to a combination folding cot and has for an object the provision of an improved arrangement whereby the device may be used as a cot either of the ordinary type or may be used as a folding addition to a cot or support of any suitable kind.

SANITARY SCREEN.—G. A. SLEIGHT, Hyde Park, N. Y. The invention provides an imperforate inclined lead to a perforated platform adapted to receive and hold disinfectants in crystal form, whereby the said disinfectant may be distributed initially over the entire under surface of the screen and, as worn away, will be concentrated at the point of greatest need therefore until entirely dissipated.

JAR CAP.—G. A. BROSIUS, R. F. D. No. 4, Jersey Shore, Pa. An object in this invention is the provision of a cap arranged with a flexible covering plate which normally is convex, but will respond to the action of vacuum and more to a concave position when the vacuum in the jar has reached a certain tension.

HINGE AND AWNING BLINDS.—L. S. CHASEY, 213 Oakland St., Red Bank, N. J. This invention provides a protection for a window against cold, rain, or other elements, and against sunlight or the like. It consists of a combination contrivance, the device being adapted to be closed as storm protection or to be swung open on either vertical or horizontal hinges according to the weather or other conditions to be met.

SPRING HINGE.—C. DIENER, 1421 Myrtle Ave., Brooklyn, New York, N. Y. This invention has reference to door hinges of the self-closing type and it improves and simplifies the construction and operation of hinges of this character, and so designed that the door can be automatically locked open in any desired position.

STOPPER.—A. YOUDELMAN, 2257 3rd Ave., New York, N. Y. The invention refers more particularly to rubber or rubber-composition stoppers for sinks, tubs, washboards, etc. The object of the invention is the provision of a simple, strong and inexpensive stopper which

STOPPER FOR SINKS, TUBS, ETC.

will not leak at the connection of the manipulating means with the body of the plug. The engraving shows a perspective view of a preferred form of the invention.

STAND FOR GLASS PERCOLATORS.—R. KOHN, 43 E. 19th St., New York, N. Y. The invention relates to improvements in coffee percolators or the like and more particularly to an improved stand for glass percolators or that type of percolator in which the coffee only comes in contact with glass parts, or substantially so, so that oxidation of the coffee is obviated.

MIRROR.—C. E. COX, Box 417, Pennington, N. J. The mirror is of the portable type and especially adapted for shaving and like purposes of the toilet, wherein a mirror proper or reflectors is provided, and a support connected with the mirror in such manner that the mirror may be supported in the manner of an easel on a chiffonnier, dresser, or table, or it may be suspended from a fixed support, and means provide for permitting the support to be attached to a window blind or shade.

Machines and Mechanical Devices

CAMERA.—J. L. PRUNTY, P. O. Box 381, Wamego, Kan. The invention provides a device by means of which an autograph, title, or other legible matter may be registered upon a film and which, when the film is subsequently developed, will constitute a part thereof and appear in the print which is made in the usual manner from the developed film.

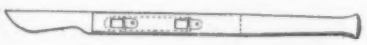
EXHAUSTING MACHINE.—A. W. JACKSON and H. J. BONHAM, 1920 Bay St., Los Angeles, Cal. In this instance the invention is an improvement in exhausting machines, and has for its purpose the provision of mechanism for partially exhausting the air from cans for containing fruit and food products after the cans have been filled, and before they are capped.

LOOM.—W. G. TRAUTVETTER, 262 Totowa Ave., Paterson, N. J. This invention provides a loom more especially designed for weaving a flat fabric, having interwoven bias or diagonal reinforcing threads. For this purpose use is made of an interweaving means for interweaving the warp threads, weft threads and reinforcing threads, and shifting means for guiding and shifting the reinforcing threads in a transverse direction in the rear of the interweaving means.

CAMERA SHUTTER CONTROL.—R. H. MCCARTNEY, 400 N. Maple St., Ishpeming, Mich. The invention relates to means for automatically actuating the shutter, to open the same at the expiration of a predetermined period of time from the time of setting the device, and to close the same after another predetermined period of time, thus giving the operator an opportunity to get into the field of the camera, and making the desired exposure, according to conditions, such as light value, subject, etc.

Medical Devices

SURGEON'S KNIFE.—A. W. JONES, Box 11, Randolph, Wis. Among the principal objects which the invention has in view are: to provide a knife having a removable blade and means for holding the same rigidly in service position; to provide handles for knives of the



SURGEON'S KNIFE.

character mentioned composed of parts which are separable to facilitate the sterilization or cleaning thereof; and to provide a handle which may be supplied with a variety of blades.

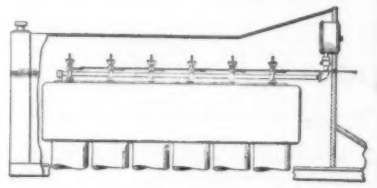
Prime Movers and Their Accessories

ROTARY EXPLOSION ENGINE.—H. W. RHOADS, Substation H, Passaic, N. J. This invention relates to internal combustion engines and particularly to what are known as rotary engines, and has for an object to provide a construction which will produce a maximum power for a given quantity of fuel. The engine may be used as an internal combustion engine, a pump, a steam engine, or other variety of power motor which uses expansion gases.

TWIN CONNECTING ROD.—M. L. SENDERLING, 333 Fairmont Ave., Jersey City, N. J. This improvement provides a rod having a plurality of full length bearing members for equalizing the strain and wear on the crank pin of an engine; provides a split bearing having directly opposed equal bearing members grouped about a crank pin to equalize the thrust strain thereon; provides means for operatively uniting connecting rods in paired relation and alined; and provides a bearing member which may be replaced or repaired.

INTERNAL COMBUSTION ENGINE.—E. J. WAGNER, North Alcaniz St., Pensacola, Fla. This invention relates to an internal combustion engine and provides means for scavenging the cylinder in an internal combustion engine at the termination of the power stroke and simultaneously opening the inlet port and recharging the cylinder with a combustible mixture.

EFFICIENCY TESTER.—J. A. DICKINSON, 423 E. 5th St., Little Rock, Ark. One of the principal objects of the invention is to provide a means whereby the degree of compression and explosion pressure of an internal



EFFICIENCY TESTER.

combustion engine may be readily ascertained, in order that the designed compression and explosion pressures being known, the efficiency of the engine may be reckoned and any trouble tending to reduce that efficiency be analyzed and located.

Pertaining to Vehicles

TRACTOR.—M. L. SENDERLING, 333 Fairmont Ave., Jersey City, N. J. This invention provides a power traction unit arranged to swing about a self-contained center; provides a steering mechanism therefor; provides alternate power and hand mechanism for operating the steering mechanism; provides for augmenting the traction exerted by said unit; provides for hanging weighted members on the carrying members automatically adjustable to the weight sustained; provides means showing the operating direction of the unit; and provides a mechanism adapted for operative engagement with a carrying body, having a bolt to swing the same on a self-contained center.

TIRE.—J. H. HAMLIN and J. C. BURFORD, care of Winston Tire & Repair Co., Winston-Salem, N. C. The tire is for use with motor vehicles, and the invention provides a tire capable of attachment to the ordinary forms of wheel rim, and of metal properly shaped to

MOTOR VEHICLE TIRE.

resist crushing stress while at the same time the tire is sufficiently resilient to counteract shock and jar imminent thereto and to prevent the transmission of shock and jar to the wheel.

CAR LIFTER.—LIZZIE HILL, Washington, N. C. The lifter is for use with motor vehicles and adapted to be arranged in garages and like places, and wherein mechanism is provided controlled by the movement of the vehicle into the garage or other place where the device is arranged for lifting the vehicle and for suporting the same with the wheels out of contact with the supporting surface for the vehicle.

MOTOR VEHICLE.—J. ALFRED, Lyndhurst, S. C. This improvement provides a motor of the manually operated type, wherein a wheel supported carriage is provided, together with a spring controlled operating shaft connected to the wheels in a manner to drive the wheels forwardly when the operating shaft is rotated forwardly and to permit the operating shaft to move freely rearwardly without affecting the wheels, and wherein mechanism is provided for compressing the springs.

HEADLIGHT FOR MOTOR VEHICLES.—C. H. STUCKE and C. F. STUCKE. Address the former, Springfield, Minn. This invention provides a headlight and a mounting therefor, for connecting the headlight to the vehicle, in such manner that the beam of light thrown by the headlight will follow the direction of turning of the vehicle, instead of extending straight ahead parallel with the long axis of the vehicle.

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

NEW BOOKS, ETC.

THE SCIENCE OF MUSICAL SOUNDS. By Dayton Clarence Miller, D.Sc. New York: The Macmillan Company, 1916. 8vo.; 294 pp.; illustrated. Price, $2.50.

An extremely rich field is explored by Dr. Miller in this most attractive work, which consists of a transcript of eight Lowell Lectures. The author's indefatigable research in connection with musical sounds, and his ability to express himself in language that is pleasing and clear to the general reader, are evident in the strong appeal of his work, which is augmented by photographs of his unique equipment and experiments; there are also some 35 photographs of sounds from various instruments, including reproductions from the Sextette in Lucia di Lammermoor. The first lecture deals with sound and sound waves, and paves the way to an understanding of what follows; succeeding lectures discuss the characteristics of tones, methods used in recording and photographing sound waves, the analysis and synthesis of harmonic curves, the influence of horn and diaphragm on sound waves, the tone qualities of different musical instruments, and physical characteristics of the vowels. The final chapter contains much relating to "opera in English" that will be new to music lovers, while it suggests the conditions that must be met in order to make such translations vocally successful. It will be seen that the lectures cover all three phases of acoustic phenomena—the intellectual, the utilitarian, and the aesthetic. While their value to the physicist and the musician is immediately apparent, the manner in which their material is presented is such as strongly to attract the general public.

WIRELESS TELEGRAPHY. By Dr. J. Zenneck, Professor of Physics at the Technical High School of Munich. Translated by A. E. Seelig, E. E. New York: McGraw-Hill Book Company, 1915. 8vo.; 463 pp.; illustrated. Price, $4 net.

In giving us a faithful translation of Zennick, Mr. Seelig has earned the gratitude of those who are unable to follow this authority in his own language. Originally designed as an abridgment of his larger work, "Elektromagnetische Schwingungen und drahtlose Telegraphie," rapid development in the art caused the author to change radically the scope and material of the book, retaining, however, the same mathematical premises. Since it is difficult at this stage to determine just what is, and what is not, of practical importance, Dr. Zennick allows himself to be influenced by his own standpoint as a physicist to the extent that he frequently discusses devices that involve a new physical idea, though these may as yet be unused. In excuse, he urges that "individual views diverge widely and seem to be influenced less by scientific reasons than by patent rights." He presents a number of problems which the laboratory and actual practice have alike failed to solve. Although the achievements of America and of Europe outside of Germany are given due credit, German knowledge and practice are naturally emphasized; this should prove an incentive rather than a discouragement to the study of his work, for Germany's inventors and engineers have played no negligible part in the development of wireless telegraphy.

FATIGUE STUDY. A First Step in Motion Study. By Frank B. Gilbreth, Member of American Society of Mechanical Engineers, and Lillian M. Gilbreth, Ph.D. New York: Sturgis & Walton Company, 1916. 12mo.; 159 pp.; illustrated. Price, $1.50 net.

There are two kinds of fatigue, the necessary and the unnecessary; but much fatigue that we formerly put into the first class is gradually being relegated to the second. The teaching of this book aims at the elimination of unnecessary fatigue by simplification of the motions made in industrial operations, and provides for rapid recovery from such tiredness as is natural. The methods used, and their scientific bases, are thoroughly explained, from the survey of the old practice to the successful establishment of the new. A bricklayer who was handling 120 bricks an hour in the haphazard way increased this to 350 an hour by the new way of working, and was less tired at the close of the day. Great emphasis is laid upon such elementary methods of studying fatigue and its elimination as do not call for the expert, with his laboratory equipment, although these more difficult methods are not entirely neglected. The work as a whole is designed to meet the commoner needs, and the reader who follows the authors carefully may at once understand and apply the methods given.

INCLUDING YOU AND ME. By Strickland Gillilan. Chicago: Forbes & Company, 1916. 12 mo.; 191 pp. Price, $1 net.

If you liked "Including Finnigin," you will like "Including You and Me"; it is in the author's sunniest mood, and discovers a vein of gold in the humblest quarts of humanity. Those whose early days were passed among country scenes will appreciate the atmosphere of reality with which the author surrounds "The General Store," the graduation exercises, "The Little Local Train," and other such scenes and objects so important in the old-time rural life that the trolley, the telephone, education and the heating plant are slowly but surely revolutionizing.

Notes and Queries.

Kindly keep your queries on separate sheets of paper when corresponding about such matters as patents, subscriptions, books, etc. This will greatly facilitate answering your questions, as in many cases they have to be referred to experts. The full name and address should be given on every sheet. No attention will be paid to unsigned queries. Full hints to correspondents are printed from time to time and will be mailed on request.

(14118) J. O. M. asks: 1. One cold evening I was out skating and on returning home I seated myself near the fire—stove—after a bit I got up to turn the damper, as the stove was too hot, and as soon as I touched the damper I received an electric shock that nearly knocked me down, and ever since that I would receive a shock and an electric spark would fly from my fingers. Can you explain the cause of this phenomenon? 2. A fly wheel or emery wheel, etc., in motion, tends to pull from the center and go in a straight line, caused by the centrifugal force. If this is so, then why is a body pulled towards the center of the earth, which is the center of gravity? Does it not seem that the centrifugal force of the earth would tend to throw objects off of the earth until there would be no earth? Do not other planets affect the earth motion more than anything else? A. 1. The sparks of electricity which you gave and received were produced by friction, the friction of your feet upon the wool of a carpet or something like that. These sparks are very easily produced in cold weather when the air is dry. Children often rub their shoes on the carpet and then touch a person with their finger tip, and give a shock. A gas jet may be lighted in this way. 2. The earth does exert centrifugal force just as you say, but it does not go fast enough to throw off anything from its equator even. It must go more than 17 times as fast to cause anything to fly off from the equator. The actual effect at the equator is to lighten a body 1/289, or to make 289 pounds seem to weigh 288 pounds on a spring balance.

(14119) G. N. G. asks: I have noticed recently, especially during cold weather, that shortly after I begin to use my typewriter I find it covered with small drops of water. This typewriter is kept in a spare room which is never heated except at night. It is within about ten minutes after the steam is turned on in this room that I notice the water collecting on the typewriter. If this water is not wiped off it stays on for probably an hour, or until it seemingly evaporates of its own free will. A. The moisture condenses upon your typewriter because the metal machine is at a lower temperature than the air of the room. The trouble can be remedied by warming the typewriter. The air of the room is probably not damper than the air outside as a usual thing, but the chilling of the air in contact with the cold machine causes the moisture to condense upon it. The action is exactly the same as the deposit of dew in a summer evening on the cool leaves of plants. The dew dries off the machine when it becomes as warm as the air in the room. The obvious remedy is to warm the typewriter. Place it near the fire which is warming the room, and let it get warm ahead of the room.

(14120) J. M. W. asks: I am now trying to make a storage battery, and would like to inquire of your chemists the formula for the filling of the grids on the plates, both negative and positive. Kindly advise me the names of the ingredients and their proportions used in either plate. After filling the plates with the preparation I am inquiring about, how long would you advise me to bake same, and to what degree of Fahrenheit. A. The materials used in filling the grids for a storage battery are litharge and red lead. These are made into pastes with sulphuric acid, glycerine and water. The glycerine and concentrated acid are mixed in equal parts. After the mixture has cooled, twice as much water is added, so that two-thirds of the mixture is water. The paste of litharge is made by stirring 9 pounds of litharge into a pint and a half of the mixture. Pressure is used to compact the paste and fill it closely into the grid. The red lead is prepared in a similar way, less liquid being necessary. One pint and a third of the mixture is used with 9 pounds of red lead. The plates are then dried in the air or in an oven at about 200° Fahr. We can furnish you with Lyndon's Storage Battery Engineering for $4, in which full instructions are to be found.

(14121) C. H. asks: Will ordinary clean sand conduct sound—that is, the same as clay—for instance, or for that matter some other earths—or will it act as a deafener or muffler of sound? A. Dry sand lying loose, not packed, is not a good conductor of sound. If put under pressure it conducts sound quite well. The same is true of any loose material. Such material cannot transmit sound from one particle to another easily. The sound must be carried across from particle to particle by the intervening air, and it is thus enfeebled.

DELCO

ELECTRIC CRANKING LIGHTING IGNITION

The Sale is Half Made when the Specifications Read DELCO Equipment

THERE is an extra margin of security, built into Delco Equipment, that means peace of mind to the motor car owner.

Delco Equipment is not just "good enough"—

It is designed and built to meet emergency requirements—to stand up under unusual operating conditions—

And—as a logical result, to perform unfailingly the day after day and month after month service that means contentment and satisfaction to the owner.

Delco Starting, Lighting and Ignition Equipment is a confidence inspiring item in the specifications of any motor car.

Motor Car buyers, in constantly increasing numbers, are demanding—and getting—Delco Equipped Cars

The Dayton Engineering Laboratories Company
Dayton, Ohio